Contractors' & Engineers' Purchasing Guide

Monthly news and classified lists of machinery and supplies for engineers, contractors, and other purchasers of construction equipment.

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Where to Purchase

A comprehensive Directory of the leading machinery and supply manufacturers arranged for the convenience of engineers and contractors who may desire to secure catalogs or prices on construction equipment. Where the name of a manufacturer is preceded by a star (*) it indicates that the user of the directory may secure further information regarding the products of this manufacturer by referring to his advertisement in this issue of the Guide. The index to advertisers will be found on page facing the inside back cover.

ACETYLENE
Linde Air Products Co., N. Y. C.
Prest-O-Lite Co., Indianapolis, Ind.

ADDING MACHINES
*Marchant Calc. Machine Co., Oakland, Cal.
*Monroe Calculating Machine Co., Orange, N. J.

AIR AND GAS WASHERS
*Spray Engineering Co., Boston, Mass.

AIR COMPRESSORS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Indiana Air Pump Co., Indianapolis, Ind.
*Nordberg Mfg. Co., Milwaukee, Wis.
*United Iron Works Co., Kansas City, Mo.
*Worthington Pump & Mchy. Corp., N. Y. C.
Belmont Iron Works, Philadelphia, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
De La Vergne Machine Co., N. Y. C.
Gardner Governor Co., Quincy, Ill.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., N. Y. C.
Norwalk Iron Works Co., South Norwalk, Conn.
Standard Elec. & Elevator Co., Baltimore, Md.
Stratton & Bragg Co., Petersburg, Va.
Sullivan Mchy. Co., Chicago, Ill.
Waterloo Constr. Mchy. Co., Waterloo, Ia.
Westinghouse Trac. Brake Co., Wilmerding, Pa.

ARC LAMPS
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ARCHITECTURAL IRON WORK
*Stewart Iron Works, Cincinnati, O.
Chesapeake Iron Works, Baltimore, Md.
Dietrich Bros., Baltimore, Md.
Hirsch Rolling Mill Co., St. Louis, Mo.
Snead Arc. Iron Works, Louisville, Ky.

ARMORED CONCRETE PAVEMENTS
*Truscon Steel Co., Youngstown, Ohio.

ARTESIAN WELL DRILLS AND PUMPS
Am. Well Works, Aurora, Ill.

ASBESTOS, ETC.
*Carey Co., Philip, Cincinnati, Ohio.
Dominion Asbestos & Rubber Corp., N. Y. C.
Keasbey & Mattison Co., Ambler, Pa.

ASH HANDLING MACHINERY
*Haiss Mfg. Co., Geo., New York.
*Otterson Auto Eductor Co., Springfield, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Byers Mach. Co., J. F., Ravenna, Ohio.
Green Eng. Co., East Chicago, Ind.
Guarantee Constr. Co., N. Y. C.
Jeffrey Mfg. Co., Columbus, Ohio.
Portable Mchy. Co., Passaic, N. J.
Webster Mfg. Co., Tiffin, O.

ASPHALT
*Atlantic Refining Co., Philadelphia, Pa.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Barrett Co., New York.
*Standard Oil Co. of Ind., Chicago, Ill.
*Texas Co., N. Y. C.
*Warren Bros. Co., Boston, Mass.
Gulf Refining Co., Pittsburgh, Pa.
Standard Oil Co. of N. Y., N. Y. C.
Standard Oil Co. of N. J., Newark, N. J.
U. S. Asphalt Refining Co., N. Y. C.

ASPHALT MACHINERY
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Dyar Supply Co., Cambridge, Mass.
*Equitable Asphalt Maint. Co., Kansas City, Mo.
*Kinney Mfg. Co., Boston, Mass.
*Littleford Bros., Cincinnati, O.
*Warren Bros. Co., Boston, Mass.
Hetherington & Berner, Indianapolis, Ind.

ASPHALT PLANTS
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Warren Bros. Co., Boston, Mass.
Austin Co., Inc., F. C., Chicago, Ill.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, Ohio.
Hetherington & Berner, Indianapolis, Ind.

ASPHALT SURFACE HEATERS
*Barber Asphalt Paving Co., Philadelphia, Pa.

ASPHALT TOOL FURNACES
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Littleford Bros., Cincinnati, Ohio.

BACKFILLERS
*Koehring Machine Co., Milwaukee, Wis.
*Pawling & Harnischfeger, Milwaukee, Wis.
Austin Co., Inc., F. C., Chicago, Ill.
American Cement Mchy. Co., Inc., Keokuk, Ia.
Byers Mach. Co., J. F., Ravenna, Ohio.
Oshkosh Mfg. Co., Oshkosh, Wis.
Parsons Co., Newton, Ia.
Waterloo Constr. Mchy. Co., Waterloo, Ia.

BAR BENDERS AND CUTTERS
Electric Welding Co., Pittsburgh, Pa.
Hinman & Co., D. A., Sandwich, Ill.

BAR CHAIRS, REINFORCING
*Truscon Steel Co., Youngstown, Ohio.
Concrete Steel Co., N. Y. C.
Universal Clamp Co., Chicago, Ill.

BAR IRON
Aborn Steel Co., Inc., N. Y. C.
Bethlehem Steel Co., So. Bethlehem, Pa.
Carbon Steel Co., Pittsburgh, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Eddystone Steel Co., Crum Lynne, Pa.
Franklin Steel Works, Franklin, Pa.
Gulf States Steel Co., Birmingham, Ala.
Hirsch Rolling Mill Co., St. Louis, Mo.
Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
Lackawanna Steel Co., Lackawanna, N. Y.
Midvale Steel & Ordnance Co., Philadelphia, Pa.
Republic Iron & Steel Co., Youngstown, O.
St. Louis Screw Co., St. Louis, Mo.

BELTING, RUBBER
*Goodyear Tire & Rubber Co., Akron, O.
Allen Mfg. Co., W. D., Chicago, Ill.
Carpenter & Co., Geo. B., Chicago, Ill.
Fairbanks Co., The, N. Y. C.
Goodall Rubber Co., Inc., Philadelphia, Pa.
Hopkins-Benedict Co., Chicago, Ill.
Imperial Belting Co., Chicago, Ill.
Kelley-Derby Co., Inc., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
McMaster-Carr Supply Co., Chicago, Ill.
Mulconroy Co., Inc., Philadelphia, Pa.

Pa. Rubber Co., Jeanette, Pa.
Revere Rubber Co., Chelsea, Mass.
Salisbury & Co., Inc., W. H., Chicago, Ill.
Southern Supply & Equip. Co., St. Louis, Mo.
Southern Rubber & Belt. Co., Houston, Tex.
Union Asbestos & Rubber Co., Chicago, Ill.
Wood, Guilford S., Chicago, Ill.

BENDING MACHINES (PIPE)
***Amer. Pipe Bending Mach. Co., Boston, Mass.**
Hinman Co., D. A., Sandwich, Ill.
Walworth Mfg. Co., Boston, Mass.

BINS, STORAGE
***Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.**
Berger Mfg. Co., Canton, Ohio.
Galion Iron Works & Mfg. Co., Galion, Ohio.
Green Engineering Co., Chicago, Ill.
Ransome Concrete Mchy. Co., Dunellen, N. J.

BLASTING SUPPLIES (See Explosives)

BLOCKS AND TACKLE
Boston & Lockport Block Co., East Boston, Mass.
Broderick & Bascom Rope Co., St. Louis, Mo.
Topping Bros., N. Y. C.
Upson-Walton Co., Cleveland, Ohio.

BLOWERS, PRESSURE
***De Laval Steam Turbine Co., Trenton, N. J.**
American Gas Furnace Co., N. Y. C.

BLUE PRINT MACHINES
Indianapolis Blue Print & S'ply Co., Ind'apolis.

BLUE PRINT PAPERS
***Kolesch & Co., New York.**
Indianapolis Blue Print & S'ply Co., Ind'apolis.

BOILERS
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Babcock & Wilcox Co., N. Y. C.
Cameron & Barkley Co., Charleston, S. C.
Casey-Hedges Co., Chattanooga, Tenn.
Chandler & Taylor Co., Indianapolis, Ind.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Cole Mfg. Co., Newman, Ga.
Erie City Iron Works, Erie, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Hartley Boiler Works, Montgomery, Ala.
Heine Safety Boiler Co., St. Louis, Mo.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Industrial Works, Bay City, Mich.
Lombard Iron Works, Augusta, Ga.
Lord & Burnham Co., Irvington, N. Y.
Mecklenburg Iron Works, Charlotte, N. C.
Murray Iron Works Co., Burlington, Ia.
New Bern Iron Wks. & Sup. Co., New Bern, N. C.
Petroleum Iron Works Co., Sharon, Pa.
Randle Mchy. Co., Cincinnati, O.
Schofield Iron Works, Macon, Ga.
Traylor Engr. & Mfg. Co., Allentown, Pa.
Valk & Murdoch Co., Charleston, S. C.
Vogt Mchy. Co., Inc., Louisville, Ky.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

BOLTS, NUTS, NAILS, RIVETS, SPIKES
American Spike Co., N. Y. C.
American Screw Co., Providence, R. I.
American Steel Export Co., N. Y. C.
Ames, W. & Co., Jersey City, N. J.
Beck & Corbitt Iron Co., St. Louis, Mo.
Bethlehem Steel Co., Bethlehem, Pa.
Brown Bag Filling Mach. Co., Fitchburg, Mass.
Camden Forge Co., Camden, N. J.
Clark Bros. Bolt Co., Milldale, Conn.
Grant, Robt., N. Y. C.
Hoffman & Co., R. C., Inc., Baltimore, Md.
Hubbard Pressed Steel Co., Niles, O.
Larkin, J. K., N. Y. C.
Midvale Steel & Ordnance Co., Philadelphia, Pa.
Milton Mfg. Co., Milton, Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Progressive Mfg. Co., Torrington, Conn.
Republic Iron & Steel Co., Youngstown, O.
Rhode Island Tool Co., Providence, R. I.
Russell, Bursdall & Ward Co., Port Chester, N. Y.
Ryerson & Son, J. T., N. Y. C.
St. Louis Screw Co., St. Louis, Mo.
Topping Bros., N. Y. C.

BRACES, TRENCH
***Clow & Sons, J. B., Chicago, Ill.**
***Waldo Bros. & Bond Co., Boston, Mass.**
Duff Mfg. Co., Pittsburgh, Pa.

BRASS GOODS
***Mueller Mfg. Co., H., Decatur, Ill.**
***Union Water Meter Co., Worcester, Mass.**
Central Brass Co., Cleveland, O.
Glauber Brass Mfg. Co., Cleveland, O.
Hayes Mfg. Co., Erie, Pa.
United Brass Mfg. Co., Cleveland, O.

BRICK, PAVING (See Paving Brick)

BRIDGES
*Chicago Bridge & Iron Works, Chicago, Ill.
***Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.**
American Bridge Co., N. Y. C.
Bellefontaine Bridge & Steel Co., Pittsburgh, Pa.
Belmont Iron Works, Philadelphia, Pa.
Berlin Constr. Co., Berlin, Conn.
Bethlehem Steel Bridge Corp., Bethlehem, Pa.
Boston Bridge Works, Boston, Mass.
Champion Bridge Co., Wilmington, O.
Chesapeake Iron Works, Baltimore, Md.
Eastern Bridge & Struc. Co., Worcester, Mass.
Eichleay Co., J. Jr., Pittsburgh, Pa.
Fort Pitt Bridge Works, Pittsburgh, Pa.
Foundation Co., N. Y. C.
Ingalls Iron Works, Birmingham, Ala.
Inter. Steel & Iron Co., Evansville, Ind.
King Bridge Co., Cleveland, O.
Louisville Bridge & Iron Co., Louisville, Ky.
McClintic Marshall Co., Pittsburgh, Pa.
Milwaukee Bridge Co., Milwaukee, Wis.
Minn. Steel & Mchy. Co., Minneapolis, Minn.
Missouri Vy. Bdge. & Iron Co., Leavenworth, Kan.
Morava Constr. Co., Chicago, Ill.
Mt. Vernon Bridge Co., Mt. Vernon, Ohio.
Penn. Bridge Co., Beaver Falls, Pa.
Richmond Struc. Steel Co., Richmond, Va.
Riverside Bridge Co., Martins Ferry, O.
Toledo Bridge & Crane Co., Toledo, O.
Virginia Bridge & Iron Co., Roanoke, Va.
Wisc. Bridge & Iron Co., North Milwaukee, Wis.

BUCKETS, AUTOMATIC DUMPING
Lakewood Engineering Co., Cleveland, O.

BUCKETS, CLAM SHELL
***Haiss Mfg. Co., Inc., N. Y. C.**
Advance Eng. Co., Cleveland, O.
Blaw-Knox Co., Pittsburgh, Pa.
Brosius, E. E., Pittsburgh, Pa.
Brown Hoisting Mchy. Co., Cleveland, O.
Byers Mach. Co., J. F., Ravenna, O.
Hayward Co., N. Y. C.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Engineering Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Orton & Steinbrenner, Chicago, Ill.
Owen Bucket Co., Cleveland, O.
Vulcan Iron Works, Jersey City, N. J.
Williams Co., G. H., Erie, Pa.

BUCKETS, CONCRETE
***Rochester Can Co., Rochester, N. Y.**
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Smith Co., T. L., Milwaukee, Wis.
Union Iron Works, Inc., Hoboken, N. J.

BUCKETS, DREDGING AND EXCAVATING
Blaw-Knox Co., Pittsburgh, Pa.
Fairbanks Steam Shovel Co., Marion, O.
Insley Mfg. Co., Indianapolis, Ind.
Kiesler Co., J. F., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Monighan Machine Co., Chicago, Ill.
Union Iron Works, Inc., Hoboken, N. J.

BUCKETS, DRAGLINE
Brown Hoisting Mach. Co., Cleveland, O.
Hayward Co., N. Y. C.
Monighan Machine Co., Chicago, Ill.
Sauerman Bros., Chicago, Ill.

BUCKETS, ORANGE PEEL
***Haiss Mfg. Co., N. Y. C.**
Hayward Mfg. Co., N. Y. C.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
McMyler Interstate Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Owen Bucket Co., Cleveland, O.
Vulcan Iron Works, Jersey City, N. J.

Where to Purchase

BUILDINGS, STEEL
- ***Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.**
- ***Truscon Steel Co., Youngstown, O.**
- Belmont Iron Works, Philadelphia, Pa.
- Blaw-Knox Co., Pittsburgh, Pa.
- Ferguson Co., H. K., Cleveland, O.
- Liberty Steel Products Co., Chicago, Ill.
- Milliken Bros. Mfg. Co., N. Y. C.
- Pruden Co., C. D., Baltimore, Md.
- Vaile & Young, Baltimore, Md.
- Wisconsin Bridge & Iron Co., N. Milwaukee, Wis.

BUNKS AND COTS
- Fort Pitt Bedding Co., Pittsburgh, Pa.
- Southern Rome Co., Baltimore, Md.

CABLES (See Wire and Cables)

CABLEWAYS
- Allen Eng. Co., Philadelphia, Pa.
- Blaw-Knox Co., Pittsburgh, Pa.
- Broderick & Bascom Rope Co., St. Louis, Mo.
- Clinton Wright Wire Co., Worcester, Mass.
- Flory Mfg. Co., S., Bangor, Pa.
- Lidgerwood Manufacturing Co., New York.
- Roebling Sons Co., J. A., Trenton, N. J.
- Sauerman Bros., Chicago, Ill.
- Waterbury Co., N. Y. C.

CAISSONS
- American Bridge Co., N. Y. C.
- Foundation Co., N. Y. C.
- Lackawanna Steel Co., N. Y. C.
- O'Rourke Eng. & Constr. Co., N. Y. C.

CALCULATING MACHINES
- *Marchant Calc. Machine Co., Oakland, Cal.
- ***Monroe Calculating Machine Co., Orange, N. J.**

CANS FOR ASHES AND GARBAGE
- ***American Can Co, N. Y. C.**
- ***Buffalo Mun. Equip. Co., Buffalo, N. Y.**
- ***Rochester Can Co., Rochester, N. Y.**
- ***Safety San. Rub. Box Co., Columbus, O.**
- ***Steel Basket Co., Cedar Rapids, Ia.**

CARS, CONCRETE
- Chase Fdry. & Mfg. Co., Columbus, O.
- Easton Car & Constn. Co., New York.
- Lakewood Engineering Co., Cleveland, O.
- Oliver Mfg. Co., Knoxville, Tenn.
- Smith Co., T. L., Milwaukee, Wis.

CARS, INDUSTRIAL V. DUMPING
- Atlas Car & Mfg. Co., Cleveland, O.
- Chase Fdry. & Mfg. Co., Columbus, O.
- Easton Car & Constr. Co., N. Y. C.
- Elec. Wheel Co., Quincy, Ill.
- General Equip. Co., N. Y. C.
- Georgia Car & Loco. Co., Atlanta, Ga.
- Insley Mfg. Co., Indianapolis, Ind.
- Kilbourne & Jacobs Mfg. Co., Columbus, O.
- Koppel Ind. Car & Equip. Co., N. Y. C.
- Lakewood Engineering Co., Cleveland, O.
- Light Railway Equip. Co., Philadelphia, Pa.
- Oliver Mfg. Co., W. J., Knoxville, Tenn.
- Ramapo Iron Works, Hillburn, N. Y.
- Smith Co., T. L., Milwaukee, Wis.
- Southern Iron & Equip. Co., Atlanta, Ga.
- United Iron Works, Kansas City, Mo.
- Whiting Fdry. Equip. Co., Harvey, Ill.

CARTS, CONCRETE
- Insley Mfg. Co., Indianapolis, Ind.
- Lakewood Engineering Co., Cleveland, O.
- Ransome Concrete Mach. Co., Dunellen, N. J.
- Smith Co., T. L., Milwaukee, Wis.
- Toledo Wheelbarrow Co., Toledo, Ohio.

CAST IRON PIPE
- ***American Cast Iron Pipe Co., Birmingham, Ala.**
- ***Camden Iron Works, Camden, N. J.**
- ***Central Fdry. Co., N. Y. C.**
- ***Clow & Sons, J. B., Chicago, Ill.**
- ***Lynchburg Fdry. Co., Lynchburg, Va.**
- ***U. S. Cast Iron Pipe & Fdry Co., Burlington, N. J.**
- ***Warren Fdry. & Mach. Co., N. Y. C.**
- ***Wood & Co., R. D, Philadelphia, Pa.**

CASTINGS, IRON AND STEEL
- ***American Cast Iron Pipe Co., Birmingham, Ala.**
- ***Camden Iron Works, Camden, N. J.**
- ***Central Fdry. Co., N. Y. C.**
- ***Flower Valve Mfg. Co., Detroit, Mich.**
- ***Lynchburg Fdry. Co., Lynchburg, Va.**
- ***U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.**
- ***Warren Fdry. & Mach. Co., N. Y. C.**
- American Bridge Co., N. Y C.
- Chain Belt Co., Milwaukee, Wis.
- Gray Iron Fdry. Co., Reading, Pa.
- Jeffrey Mfg. Co., Columbus, O.
- Lakewood Eng. Co., Cleveland, O.
- Link-Belt Co., Chicago, Ill.
- Marion Malleable Iron Works, Marion, Ind.
- Marion Steam Shovel Co., Marion, O.
- Sessions Fdry. Co., Bristol, Conn.

CASTINGS, STREET AND SEWER
- ***Central Fdry. Co., N. Y. C.**
- ***Lebanon Machine Co., Lebanon, O.**
- ***Lynchburg Fdry. Co., Lynchburg, Va.**
- ***U. S. Cast Iron Pipe & Fdry Co., Burlington, N. J.**
- Casey-Hedges Co., Chattanooga, Tenn.

CAST IRON MANHOLES
- ***Madison Fdry Co., Cleveland, O.**
- ***S. E. T. Valve & Hydrant Co., New York.**

CATCH BASINS
- ***Clark Co., H. W., Mattoon, Ill.**
- ***Dee Co., W. E., Chicago, Ill.**
- ***Lebanon Machine Co., Lebanon, N. H.**
- ***Madison Fdry. Co., Cleveland, O.**
- ***Thompson-Fleming Co., Inc., Buffalo, N. Y.**
- ***U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.**
- ***Zieg Mfg. Co., F. B., Fredericktown, O.**
- Casey-Hedges Co., Chattanooga, Tenn.

CATCH BASINS CLEANING APPARATUS
- ***Otterson Auto Eductor Co., Springfield, O.**
- ***Springfield Eng. Co., Springfield, O.**

CAULKING MACHINERY
- ***Mueller Mfg. Co., H. Decatur, Ill.**
- ***Smith Mfg. Co., A. P., East Orange, N. J.**

CAULKING MATERIALS
- ***Leadite Co, Philadelphia, Pa.**
- ***Mueller Mfg. Co., H., Decatur, Ill.**
- ***United Lead Company, New York.**

CEMENT
- ***Alpha Portland Cement Co., Easton, Pa.**
- ***Atlas Portland Cement Co., New York.**
- ***Penna. Cement Co., New York.**
- Dixie Portland Cement Co., Chattanooga, Tenn.
- Lehigh Portland Cement Co., Allentown, Pa.
- Portland Cement Assn., Chicago, Ill.
- Universal Portland Cement Co., Chicago, Ill.

CEMENT INSPECTION
- ***Allentown Testing Laboratories, Allentown, Pa.**
- ***Pittsburgh Testing Laboratories, Pittsburgh, Pa.**
- Hunt & Co., Robert W., Chicago, Ill.

CEMENT MAKING MACHINERY
- ***Allis-Chalmers Mfg. Co., Milwaukee, Wis.**
- Austin Co., Inc., F. C., Chicago, Ill.
- Fuller-Lehigh Co., Fullerton, Pa.
- Vulcan Iron Works, Wilkesbarre, Pa.

CENTRIFUGAL PUMPS
- ***Allis-Chalmers Mfg. Co., Milwaukee, Wis.**
- ***Camden Iron Works, Camden, N. J.**
- ***Delaval Steam Turbine Co., Trenton, N. J.**
- ***Fairbanks, Morse & Co., Chicago, Ill.**
- ***Indiana Air Pump Co., Indianapolis, Ind.**
- ***United Iron Works Co., Kansas City, Mo.**
- ***United Lead Company, New York.**
- ***Yeomans Bros. Co., Chicago, Ill.**
- American Well Works, Aurora, Ill.
- Domestic Engr. & Pump Co., Shippensburg, Pa.
- Keystone Driller Co., Beaver Falls, Pa.

CHAINS
- ***Niagara Metal Stamp. Wks., Niagara Falls, N. Y.**
- American Chain Co., Inc., Bridgeport, Conn.
- Blaw-Knox Co., Pittsburgh, Pa.
- Chain Belt Co., Milwaukee, Wis.
- Columbus McKinnon Chain Co., Columbus, O.
- Link-Belt Co., Philadelphia, Pa.
- Topping Brothers, New York.
- Upson-Walton Co., Cleveland, O.
- U. S. Chain & Forge Co., Pittsburgh, Pa.

Where to Purchase

CHAINS, STEEL AND MALLEABLE
Chain Belt Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.

CHECK VALVES
*Columbian Iron Works, Chattagoona, Tenn.
*Flower Valve Mfg. Co., Detroit, Mich.
*Ludlow Valve Mfg. Co., Troy, N. Y.
*Mueller Mfg. Co., H., Decatur, Ill.
Lunkenheimer Co., Cincinnati, O.

CHEMICALS FOR WATER PURIFICATION
*Du Pont de Nemours Co., Wilmington, Del.
*Electro Bleaching Gas Co., New York.
*Hooker Electrochemical Co., New York.
*Mathieson Alkali Works, Inc., New York.
*Penna. Salt Mfg. Co., Philadelphia, Pa.
Arnold Hoffman & Co., New York.

CHIMNEYS, CONCRETE
*Truscon Steel Co., Youngstown, O.
Kellogg & Co., M. W., New York.
Weber Chimney Co., Chicago, Ill.

CHIMNEYS, RADIAL BRICK
Denver Sewer Pipe & Clay Co., Denver, Col.
Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago, Ill.

CHIMNEY, STEEL
*Chicago Bridge & Iron Works, Chicago, Ill.
*Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros., Cincinnati, O.
Blaw-Knox Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

CHLORINATORS
*Wallace & Tiernan Co., Inc., New York.

CHLORINE, LIQUID (See Liquid Chlorine)

CHUTES, CONCRETE
Insley Mfg. Co. Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Ransome Conc. Mchy. Co., Dunellen, N. J.

CLIPS, WIRE ROPE
*American Steel & Wire Co., Chicago, Ill.
Broderick & Bascom Rope Co., St. Louis, Mo.
Carpenter Co., Geo. B., Chicago, Ill.
Marion Malleable Iron Works, Marion, Ind.
Roebling Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.

COAL AND ORE CONVEYING MACHINERY
*Haiss Mfg. Co., Geo., New York.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Blaw-Knox Co., Pittsburgh, Pa.
Brown Hoisting Mchy. Co., Cleveland, O.
Byers Machine Co., J. F., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Hayward Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Chicago, Ill.
Robins Conveying Belt Co., New York.
Toledo Bridge & Crane Co., Toledo, O.

COAL STORAGE SYSTEMS
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Brown Hoisting Machy. Co., Cleveland, O.
Berger Mfg. Co., Canton, O.
Green Engineering Co., East Chicago, Ind.
Guarantee Constn. Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Lidgerwood Mfg. Co., New York-
Link-Belt Co., Chicago, Ill.

COCKS, CURB AND CORPORATION
*Mueller Mfg. Co., H., Decatur, Ill.
*Union Water Meter Co., Worcester, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Glauber Brass Mfg. Co., Cleveland, O.

COLUMN CLAMPS
Blaw-Knox Co., Pittsburgh, Pa.
Hydraulic Steelcraft Co., Cleveland, O.
Insley Mfg. Co., Indianapolis, Ind.
Universal Clamp Co., Chicago, Ill.

COMPRESSORS, AIR (See Air Compressors)

CONCRETE FLOOR HARDENER
Anti-Hydro Waterproofing Co., New York.
Sonneborn Sons, Inc., L., New York.

CONCRETE MIXERS
*Jaeger Machine Co., Columbus, O.
*Koehring Machine Co., Milwaukee, Wis.
*Worthington Pump & Mchy. Corp., N. Y. C.
*Zieg Mfg. Co., F. B., Fredericktown, O.
American Cement Machine Co., Keokuk, Ia.
Austin Co., F. C., Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
Chain Belt Co., Milwaukee, Wis.
Contractors' Equipment Co., Keokuk, Ia.
Foote Concrete Mchy. Co., Chicago, Ill.
Knickerbocker Co., Jackson, Mich.
Koehring Machine Co., Milwaukee, Wis.
Lakewood Engineering Co., Cleveland, O.
Lansing Co., Lansing, Mich.
Ransome Conc. Mchy. Co., Dunellen, N. J.
Smith Co., T. L., Milwaukee, Wis.
Standard Scale & Supply Co., Pittsburgh, Pa.

CONCRETE REINFORCEMENT
*American Steel & Wire Co., Chicago, Ill.
*Truscon Steel Co., Youngstown, O.
Brown Hoisting Mchy. Co., Cleveland, O.
Carnegie Steel Co., Pittsburgh, Pa.
Clinton-Wright Wire Co., Worcester, Mass.
Concrete Steel Co., New York.
Electric Welding Co., Pittsburgh, Pa.
Lackawanna Steel Co., Lackawanna, N. Y.
Robertson Co., H. H., Pittsburgh, Pa.
Ryerson & Son, J. T., St. Louis, Mo.
T. L. Smith Co., The, Chicago, Ill.
Wickwire-Spencer Steel Corp., Worcester, Mass.

CONDENSORS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
*Worthington Pump & Mchy. Corp., New York.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Ingersoll-Rand Co., New York.

CONDUIT RODS
*Bissell Co., F., Toledo, O.
*Waldo Bros. & Bond Co., Boston, Mass.
*Turbine Sewer Machine Co., Milwaukee, Wis.

CONDUITS
American Vit. Conduit Co., N. Y. C.
Fibre Conduit Co., Orangeburg, N. Y.
Johns-Manville Co., H. W., New York City.
National Metal Moulding Co., N. Y. C.
Youngstown Sheet & Tube Co., Youngstown, O.

CONTRACTORS' SUPPLIES, DEALERS
Carpenter Co., Geo. B., Chicago, Ill.
Shannon & Co., J. Jacob, Philadelphia, Pa.

CONVEYORS, BELT
*Goodyear Tire & Rubber Co., Akron, O.
*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Chain Belt Co., Milwaukee, Wis.
Gifford Wood Co., Hudson, N. Y.
Guarantee Constn. Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Portable Mchy. Co., Passaic, N. J.

CONVEYORS, BUCKET
*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Bartlett & Snow Co., C. O., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Gifford Wood Co., Hudson, N. Y.
Guarantee Constn. Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Webster Mfg. Co., Tiffin, O.

Where to Purchase

CRANES, LOCOMOTIVE
- ***Pawling & Harnischfeger Co., Milwaukee, Wis.**
- Ball Engine Co., Erie, Pa.
- Brown Hoisting Mchy. Co., Cleveland, O.
- Bucyrus Co., South Milwaukee, Wis.
- Byers Machine Co., J. F., Ravenna, O.
- Industrial Works, Bay City, Mich.
- Link-Belt Co., Chicago, Ill.
- Locomotive Crane Co. of America, Chicago, Ill.
- Marion Steam Shovel Co., Marion, O.
- Terry Mfg. Co., Edw. F., New York.
- U. S. Crane Co., Chicago, Ill.

CRANES, TRAVELING
- ***Pawling & Harnischfeger Co., Milwaukee, Wis.**
- Brown Hoisting Mchy. Co., Cleveland, O.
- Bucyrus Co., South Milwaukee, Wis.
- Link-Belt Co., Chicago, Ill.
- Toledo Bridge & Crane Co., Toledo, O.
- U. S. Crane Co., Chicago, Ill.

CRANES, WRECKING
- Bucyrus Co., South Milwaukee, Wis.
- Industrial Works, Bay City, Mich.
- Terry Mfg. Co., Edw. F., New York.
- U. S. Crane Co., Chicago, Ill.

CREOSOTED BLOCKS, TIMBER, ETC.
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Republic Creosoting Co., Indianapolis, Ind.**
- Carbolineum Wood Preserving Co., New York.
- Jennison-Wright Co., Toledo, O.
- Wyckoff Pipe & Creosoting Co., New York.

CREOSOTING AND CREOSOTING OILS
- ***Barrett Co., New York.**
- Am. Creosoting Wks., Inc., New Orleans, La.
- Carbolineum Wood Preserving Co., New York.
- Jennison-Wright Co., Toledo, O.
- Southern Creosoting Co., Ltd., Slidell, La.
- Southern Wood Preserving Co., Atlanta, Ga.
- Wyckoff Pipe & Creosoting Co., New York.

CRUSHERS AND PULVERIZERS (See Rock Crushers)

CULVERTS, METAL
- ***American Cast Iron Pipe Co., Birmingham, Ala.**
- ***Dee Co., W. E., Chicago, Ill.**
- ***Good Roads Machinery Co., Kennett Square, Pa.**
- ***Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.**
- ***Madison Foundry Co., Cleveland, O.**
- ***Newport Culvert Co., Newport, Ky.**
- ***Russell Grader Mfg. Co., Minneapolis, Minn.**
- ***Truscon Steel Co., Youngstown, O.**
- ***Union Iron Products Co., East Chicago, Ind.**
- ***U. S. C. I. Pipe & Fdry. Co., Burlington, N. J.**
- ***Wood & Co., R. D., Philadelphia, Pa.**
- ***Zieg Mfg. Co., Fredericktown, O.**
- Berger Mfg. Co., Canton, O.
- Canton Culvert & Silo Co., Canton, O.
- Fouts Co., C. C., Middletown, O.
- Galion Iron Works & Mfg. Co., Galion, O.
- Hardesty Mfg. Co., The R., Denver, Colo.
- Southern Metal Culvert Co., Salisbury, N. C.

CURB BOXES
- ***Clark Co., H. W., Mattoon, Ill.**
- ***Madison Fdry. Co., Cleveland, O.**
- ***Mueller Mfg. Co., Decatur, Ill.**
- ***S. E. T. Valve & Hydrant Co., N. Y. C.**
- ***Thompson-Fleming Co., Inc., Buffalo, N. Y.**
- Casey-Hedges Co., Chattanooga, Tenn.

CURB STEEL PROTECTED
- ***Truscon Steel Co., Youngstown, O.**
- Concrete Steel, New York.
- Steel Protected Concrete Co., Philadelphia, Pa.

CURRENT METERS
- ***General Electric Co., Schenectady, N. Y.**
- ***Neptune Meter Co., New York.**
- ***Pittsburgh Meter Co., Pittsburgh, Pa.**
- ***Union Water Meter Co., Worcester, Mass.**
- ***Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.**

CUTTERS, PIPE, HAND
- ***Smith Mfg. Co., A. P., East Orange, N. J.**
- Armstrong Mfg. Co., Bridgeport, Conn.
- Barnes Tool Co., New Haven, Conn.
- Crane Co., Chicago, Ill.
- Erie Tool Works, Erie, Pa.
- Walworth Mfg. Co., Boston, Mass.
- Wells & Son Co., F. E., Greenfield, Mass.

CUTTERS, ROD AND WIRE
- ***Worthington Pump & Mchy. Corp., New York.**
- Carpenter & Co., Geo. B., Chicago, Ill.
- Koehring Machine Co., Milwaukee, Wis.
- Ransome Concrete Mchy. Co., New York.

CUTTING AND WELDING APPARATUS
- ***Imperial Brass Mfg. Co., Chicago, Ill.**
- MacCleod Co., Cincinnati, O.
- Milburn Co., Alexander, Baltimore, Md.
- Prest-O-Lite Co., Inc., Indianapolis, Ind.

DAMS
- Foundation Co., New York.
- O'Rourke Engineering Co., New York.

DERRICKS AND DERRICK FITTINGS
- Blaw-Knox Co., Pittsburgh, Pa.
- Byers Machine Co., Ravenna, O.
- Carnegie Steel Co., Pittsburgh, Pa.
- Dobbie Fdry. Co. & Mch. Co., Niagara Falls, N. Y.
- Hayward Co., New York.
- Insley Mfg. Co., Indianapolis, Ind.
- Lidgerwood Mfg. Co., New York.
- Shannon & Co., J. Jacob, Philadelphia, Pa.
- Terry Mfg. Co., Edw. F., New York.

DERRICKS, GUY AND STIFF-LEG
- American Hoist & Derrick Co., St. Paul, Minn.
- Byers Machine Co., Ravenna, O.
- Carpenter & Co., Geo. B., Chicago, Ill.
- Clyde Iron Works, Duluth, Minn.
- Federal Bridge & Struc. Co., Waukesha, Wis.
- Flory Mfg. Co., S., Bangor, Pa.
- Insley Mfg. Co., Indianapolis, Ind.
- Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
- Lidgerwood Manufacturing Co., New York.
- Lincoln Iron Works, Rutland, Vt.
- National Hoisting Engine Co., Harrison, N. J.
- Smith, Whitcomb & Cook Co., Barrie, Vt.
- Superior Iron Works, Superior, Wis.
- Terry Mfg. Co., Edw. F., New York.

DERRICKS, PILE DRIVING
- American Hoist & Derrick Co., St. Paul, Minn.
- Clyde Iron Works, Duluth, Minn.
- Lidgerwood Mfg. Co., New York.
- Mundy Hoist Engine Co., J. S., Newark, N. J.
- Union Iron Works, Hoboken, N. J.

DERRICKS, PIPE LAYING
- ***Mueller Mfg. Co., H., Decatur, Ill.**
- Lidgerwood Manufacturing Co., New York.

DERRICKS, REVOLVING
- Carpenter & Co., O. Th., Chicago, Ill.
- Clyde Iron Works, Duluth, Minn.
- Lidgerwood Manufacturing Co., New York.
- Terry Mfg. Co., Edw. F., New York.

DERRICKS, STEEL
- ***Taylor Portable Steel Derrick Co., Chicago, Ill.**
- American Bridge Co., New York.
- American Hoist & Derrick Co., St. Paul, Minn.
- Carnegie Steel Co., Pittsburgh, Pa.
- Clyde Iron Works, Duluth, Minn.
- Federal Bridge & Struc. Co., Waukesha, Wis.
- Hayward Co., New York.
- Hoisting Mchy. Co., New York.
- Insley Mfg. Co., Indianapolis, Ind.
- Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
- Lidgerwood Manufacturing Co., New York.
- Petroleum Iron Works Co., Sharon, Pa.
- Terry Mfg. Co., Edw. F., New York.

DERRICKS, STEEL PORTABLE
- ***Taylor Portable Steel Derrick Co., Chicago, Ill.**
- Blaw-Knox Co., Pittsburgh, Pa.
- Carnegie Steel Co., Pittsburgh, Pa.
- Clyde Iron Works, Duluth, Minn.
- Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
- Dyar Supply Co., Cambridge, Mass.
- Lidgerwood Manufacturing Co., New York.

DERRICKS, TRAVELING
- American Hoist & Derrick Co., St. Paul, Minn.
- Byers Machine Co., J. F., Ravenna, O.
- Clyde Iron Works, Duluth, Minn.
- Hayward Co., New York.
- Hoisting Engine Sales Co., New York.
- National Hoisting Engine Co., Harrison, N. J.
- Orton & Steinbrenner Co., Chicago, Ill.
- Terry Mfg. Co., Edward F., New York.

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Where to Purchase

DISINFECTING CHEMICALS

*Arnold Hoffman Co., Inc., Boston, Mass.
*Barrett Co. New York.
*Electro Bleaching Gas Co., New York.

DISTRIBUTING PLANTS, CONCRETE

*Jaeger Machine Co., Columbus, O.
American Cement Mach. Co., Inc., Keokuk, Ia.
Archer Iron Works, Chicago, Ill.
Insley Mfg. Co., Indianapolis, Ind.
Koehring Machine Co., Milwaukee, Wis.
Lakewood Engineering Co., Cleveland, O.
Pneumatic Concrete Machinery Co., New York.
Ransome Concrete Machinery Co., New York.

DITCHING MACHINES (See Excavators, Ditch and Trench)

DOORS AND SHUTTERS, STEEL ROLLING

Cornell Iron Works, New York.
Detroit Steel Products Co., Detroit, Mich.
Edwards Mfg. Co., Cincinnati, O.
Kinnear Mfg. Co., Columbus, O.
Lupton's Sons Co., D., Philadelphia, Pa.
Paxton & Vierling Iron Works, Omaha, Neb.
Variety Mfg. Co., Chicago, Ill.
Wilson Corp., J. G., New York.

DRAFTING MACHINES

Universal Drafting Machine Co., Cleveland, O.

DRAWING MATERIALS

*Economy Draw. Table & Mfg. Co., Adrian, Mich.
*Kolesch & Co., New York.
*Weber & Co., F., Philadelphia, Pa.
American Blue Print Paper Co., Chicago, Ill.
American Lead Pencil Co., New York.
Defiance Mfg. Co., New York.
Dietzgen Co., E., New York.
Gurley, W. & L. E., Troy, N. Y.
Hamilton Mfg. Co., Two Rivers, Wis.
Keuffel & Esser Co., Hoboken, N. J.

DREDGES

*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., P. O., South Milwaukee, Wis.
Hayward Co., New York.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Stockton Iron Works, Stockton, Cal.
Superior Iron Works, Superior, Wis.
Toledo Fdry. & Machine Co., Toledo, O.
Vulcan Iron Works, Jersey City, N. J.

DREDGES, DIPPER

American Steel Dredge Co., Fort Wayne, Ind.
Austin Co., F. C., Chicago, Ill.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Fairbanks Steam Shovel Co., Marion, O.
Flory Mfg. Co., S., Bangor, Pa.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.
Toledo Foundry & Machine Co., Toledo, O.

DREDGES, HYDRAULIC

Bucyrus Co., South Milwaukee, Wis.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.

DRILLS, AIR

*Independent Pneumatic Tool Co., Chicago, Ill.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Drill Co., Chicago, Ill.
Cleveland Rock Drill Co., Cleveland, O.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, CORE

*McKiernan-Terry Drill Co., New York.
Dobbins Core Drill Co., Inc., New York.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Keystone Driller Co., Beaver Falls, Pa.
Standard Diamond Drill Co., Chicago, Ill.
Star Drilling Machine Co., Akron, O.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, HAMMER

*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Chicago, Ill.
Cleveland Rock Drill Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Ryerson & Son, Jos. T., Chicago, Ill.
Sullivan Machinery Co., Chicago, Ill.
Vulcan Tool Mfg. Co., Quincy, Mass.

DRILLS, ROCK

*General Electric Co., Schenectady, N. Y.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Rock Drill Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Schramm & Son, Chris. D., Inc., Phila., Pa.
Sullivan Machinery Co., Chicago, Ill.
Wood Drill Works, Paterson, N. J.

DRINKING FOUNTAINS

*Clow & Sons, J. B., Chicago, Ill.
*Mueller Mfg. Co., H., Decatur, Ill.
*Murdock Mfg. & Supply Co., Cincinnati, Ohio.
*Puro San. Drink. Fount. Co., Haydenville, Mass.
*Rundle-Spence Mfg. Co., Milwaukee, Wis.
*Stewart Iron Works, Cincinnati, O.
*Taylor Co., Halsey W., Warren, O.
Casey-Hedges Co., Chattanooga, Tenn.
Flour City Orn. Iron Co., Minneapolis, Minn.
Glauber Brass Mfg. Co., Cleveland, O.

DRUMS, HOLDING

Blaw-Knox Co., Pittsburgh, Pa.
Hayward Co., New York.
Monighan Machine Co., Chicago, Ill.

DRYERS, ASPHALT AND CEMENT

*Allis-Chalmers Co., Milwaukee, Wis.
*Dyar Supply Co., Cambridge, Mass.
American Blower Co., Detroit, Mich.
Atlas Dryer Co., Cleveland, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
East. Iron & Machine Co., Lima, O.
Ruggles-Coles Eng. Co., New York.
Variety Iron & Steel Works, Cleveland, O.

DUMP BODIES FOR MOTOR TRUCKS

*Littleford Bros., Cincinnati, O.
Archer Iron Works, Chicago, Ill.
Heil Company, Milwaukee, Wis.

DUMP CARTS AND WAGONS

*Austin Western Road Mchy. Co., Chicago, Ill.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Ind.
*Tiffin Wagon Co., Tiffin, Ohio.
*Watson Products Corp., Canastota, N. Y.
Austin Mfg. Co., Chicago, Ill.
Eagle Wagon Works, Auburn, N. Y.
Holzbog & Bro., Geo. H., Jeffersonville, Ind.

DUST LAYING COMPOUNDS

*Barrett Co., New York.
*Dustoline for Roads Co., Summit, N. J.
*Semet-Solvay Co., Solvay, N. Y.
*Standard Oil Co. of Indiana, Chicago, Ill.
*Texas Co., New York City.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE

*Pacific Flush Tank Co., Chicago, Ill.
*Yeomans Bros. Co., Chicago, Ill.
Chicago Pump Co., Chicago, Ill.

ELECTRIC CURRENT METERS (See Current Meters)

ELECTRIC GENERATORS AND MOTORS. (See Generators, Electric.)

ELECTRIC LAMPS

*Cutter Co., Geo., South Bend, Ind.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ELECTRIC LIGHTING PLANTS

*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Triumph Electric Co., Cincinnati, O.
Western Electric Co., New York.
White & Co., J. G., New York.

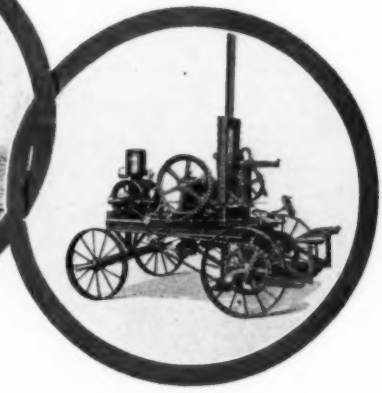
ELECTRICAL SUPPLIES

*Bissell Co., F., Toledo, O.
*Cutter Company, Geo., South Bend, Ind.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

Buy Them as a Unit

WHEEL TYPE
P&H
EXCAVATOR

POWER TRACTION
P&H BACKFILLER



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P&H TAMPER

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On city streets where work must be done with uniformity, and dispatch, the P & H combination —Excavator, Backfiller, and Tamper—is the logical equipment for the job.

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Where to Purchase

ELECTRIC TRANSFORMERS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*General Electric Co., Schenectady, New York.
*Kuhlman Electric Co., Bay City, Mich.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC WIRES AND CABLES
*American Steel & Wire Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Habirshaw Wire & Cable Co., New York.
*Hazard Mfg. Co., Wilkesbarre, Pa.
*Simplex Wire & Cable Co., Boston, Mass.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELEVATORS, BUCKET
*Austin Western Road Machy. Co., Chicago, Ill.
*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Worthington Pump & Mchy. Works, New York.
Eastern Road Machy. Co., Chicago, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Marsh & Co., Geo. C., Chicago, Ill.
Webster Mfg. Co., Tiffin, O.

ELEVATORS, CONTRACTING MATERIAL
Byers Machine Co., J. F., Ravenna, O.
Insley Mfg. Co., Indianapolis, Ind.
Ransome Concrete Machinery Co., Dunellen, N. J.
Smith Co., T. L., Milwaukee, Wis.

ELEVATORS, FACTORY
Ridgeway & Son Co., C., Coatesville, Pa.
Speidel, J. G., Reading, Pa.

ENGINEERS' AND DRAUGHTSMENS' INSTRUMENTS AND SUPPLIES
*Kolesch & Co., New York.
*Monroe Calculating Machine Co., New York.
*Weber Co., F., Philadelphia, Pa.
Buff & Buff Mfg. Co., Chicago, Ill.
Dietzgen Co., E., Chicago, Ill.
Gurley Co., W. & L. E., Troy, N. Y.
Keuffel & Esser Co., Hoboken, N. J.
Lufkin Rule Co., Saginaw, Mich.

ENGINES, GAS AND GASOLINE
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*Foos Gas Engine Co., Springfield, Ohio.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
*Worthington Pump & Mchy. Corp., New York.
Chicago Pneumatic Tool Co., Chicago, Ill.
De La Vergne Mch. Co., New York City.
Domestic Engine & Pump Co., Shippensburg, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.
Waterloo Constr. Mchy. Co., Waterloo, Ia.

ENGINES, HIGH DUTY WATER-WORKS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*Fairbanks, Morse & Co., Chicago, Ill.
*Worthington Pump & Mchy. Corp., New York.
Morris Machine Works, Baldwinsville, N. Y.

ENGINES, OIL. (See Oil Engines.)

ENGINES, PILE DRIVING AND HOISTING
Byers Machine Co., J. F., Ravenna, O.
Clyde Iron Works, Duluth, Minn.
Lidgerwood Mfg. Co., New York.

ENGINES, PUMPING
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks Morse & Co., Chicago, Ill.
*Foos Gas Engine Co., Springfield, O.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
American Gas Engine Co., Kansas City, Mo.
American Well Works, Aurora, Ill.
Dayton-Dowd Co., Quincy, Ill.
Enterprise Mchy. Co., Minneapolis, Minn.
International Harvester Co. of Am., Chicago, Ill.
Weinman Pump Mfg. Co., Columbus, O.

ENGINES, STEAM
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Nordberg Mfg. Co., Milwaukee, Wis.
Ball Engine Co., Erie, Pa.
Erie Pump & Engine Co., Medina, N. Y.
Morris Machine Works, Baldwinsville, N. Y.
Sturtevant Co., B. F., Boston, Mass.

ENGINES, TRACTION
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Fairbanks, Morse & Co., Chicago, Ill.
Oliver Tractor Co., Knoxville, Tenn.
Phoenix Mfg. Co., Eau Claire, Wis.

EXCAVATING MACHINERY
*Austin Western Road Machy. Co., Chicago, Ill.
*Koehring Machine Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Ball Engine Co., Erie, Pa.
Bay City Dredge Works, Bay City, Mich.
Buckeye Traction Ditcher Co., Findlay, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, O.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Keystone Driller Co., Beaver Falls, Pa.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.
Thew Automatic Shovel Co., Lorain, O.

EXCAVATORS, CABLEWAY
Ball Eng. Co., Erie, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, O.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.

EXCAVATORS, DITCH AND TRENCH
*Baker Mfg. Co., Springfield, Ill.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Austin Co., Inc., F. C., Chicago, Ill.
Ball Engine Co., Erie, Pa.
Bay City Dredge Works, Bay City, Mich.
Buckeye Traction Ditcher Co., Findlay, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, O.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., The, New York City.
Keystone Driller Co., Beaver Falls, Pa.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.

EXCAVATORS, DRAG-LINE
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Austin Co., Inc., F. C., Chicago, Ill.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, O.
Clyde Iron Works, Duluth, Minn.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Marsh & Co., G. C., Chicago, Ill.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Smith Co., T. L., Chicago, Ill.

EXPANDED METAL
*Truscon Steel Co., Youngstown, O.
Consolidated Expanded Metal Co., Braddock, Pa.
Northwestern Expanded Metal Co., Chicago, Ill.

EXPANSION JOINT MATERIAL
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, O.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
Robertson Co., H. H., Pittsburgh, Pa.

EXPLOSIVES
*Du Pont de Nemours & Co., E. I., Wilmington, Del.
Ætna Explosives Co., Inc., New York.
Atlas Powder Co., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

FENCING
*American Steel & Wire, Chicago, Ill.
*Stewart Iron Works Co., Cincinnati, O.
Anchor Post Iron Works, New York.
Clinton-Wright Wire Co., Worcester, Mass.

Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Cleveland, O.
Indiana Steel & Wire Co., Muncie, Ind.
Pittsburgh Steel Co., Pittsburgh, Pa.
Wickwire-Spencer Steel Corp., Worcester, Mass.

FILING EQUIPMENT
*Econ. Drawing Table & Mfg. Co., Adrian, Mich.

FILTERS, OIL
*Bowser & Co., Inc., S. F., Fort Wayne, Ind.

FILTERS, WATER
*N. Y. Continental Jewel Filter Co., Nutley, N. J.
*Norwood Engineering Co., Florence, Mass.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
*Simplex Valve & Meter Co., Philadelphia, Pa.
American Water Softener Co., Philadelphia, Pa.
International Filter Co., Chicago, Ill.
Permutit Co., New York.
Roberts Filter Mfg. Co., Darby, Pa.
Scaife & Sons Co., W. B., Pittsburgh Pa

FIRE EXTINGUISHERS, CHEMICAL
*American La France Fire Eng. Co., Elmira, N. Y.
*O. J. Childs Co., Utica, N. Y.
C. J. Cross Mfg. Co., Inc., New York.
Foamite Firefoam Co., New York.
Pyrene Mfg. Co., New York.

FIREPROOF MATERIAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Detroit Steel Prod. Co., Detroit, Mich.
General Fireproofing Co., Youngstown, O.
Keasbey & Mattison Co., Ambler, Pa.
Kinnear Mfb. Co., Columbus, O.

FIRST AID EQUIPMENT
*American-LaFrance Fire Eng. Co., Elmira, N. Y.

FLEXIBLE JOINTS
*Central Foundry Co., New York.
*Coldwell-Wilcox Co., Newburgh, N. Y.
*Crane Co., Chicago, Ill.
*United Lead Company, New York.
*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
Lunkenheimer Co., Cincinnati, O.

FLOOR, WOOD BLOCK
*Barrett Co., New York.
*Republic Creosoting Co., Indianapolis, Ind.
Jennison-Wright Co., Toledo, O.

FLUSH TANKS
*Pacific Flush Tank Co., New York.

FLUSHERS, STREET
*Municipal Supply Co., South Bend, Ind.
*Tiffin Wagon Co., Tiffin, O.

FORGES
Buffalo Forge Co., Buffalo, N. Y.
Carpenter & Co., Geo. B., Chicago, Ill.
Hauck Mfg. Co., New York.
Ingersoll-Rand Co., New York.

FORM CLAMPS
Insley Mfg. Co., Indianapolis, Ind.
Marion Malleable Iron Works, Marion, Ind.
Universal Clamp Co., Chicago, Ill.

FORMS, CONSTRUCTION
*Truscon Steel Co., Detroit, Mich.
Blaw-Knox Co., Pittsburgh, Pa.
Foote Conc. Mchy. Co., Chicago, Ill.
Hetzel Steel Form & Iron Co., Warren O.
Hydraulic Steelcraft Co., Cleveland, O.

FORMS FOR WALLS, BUILDING CONSTRUCTION
*Truscon Steel Co., Detroit, Mich.
Blaw-Knox Co., Pittsburgh, Pa.
Heltzel Steel Form & Iron Co., Warren, O.
Hydraulic Steelcraft Co., Cleveland, O.

FOUNDATIONS
American Bridge Co., New York.
Cranford Constn. Co., Cincinnati, O.
MacArthur Conc. Pile & Found. Co., New York.
Raymond Conc. Pile Co., New York.
Smith, Hauser & Mac Isaac, New York.
Underpinning & Foundation Co., New York.

FOUNTAINS. **(See Drinking Fountains.)**

GARBAGE DISPOSAL
*Destructor Co., New York.
American Reduction Co., Pittsburgh, Pa.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
Decarie Incinerator Co., Minneapolis, Minn.
Jeffrey Manufacturing Co. Columbus, O.
Morse-Boulger Destructor Co., New York.
Stacey Bates Co., Minneapolis, Minn.

GARBAGE WAGONS
*Austin Western Road Mchy. Co., Chicago, Ill.
*Autocar Co., Ardmore, Pa.
*Federal Motor Truck Co., Detroit, Mich.
*Four Wheel Drive Auto Co., Clintonville, Wis.
*Service Motor Truck Co., Wabash, Ind.
*Tiffin Wagon Co., Tiffin, O.
*Watson Products Corp., Canastota, N. Y.
*White Co., Cleveland, O.
Holzbog & Bro., Geo. H., Jeffersonville, Ind.

GAS ENGINES. **(See Engines, Gas and Gasoline.)**

GAS METERS
*Builders Iron Foundry, Providence, R. I.
*General Electric Co., Schenectady, New York.
*Pittsburg Meter Co., East Pittsburgh, Pa.

GAS PRODUCERS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Camden Iron Works, Camden, N. J.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

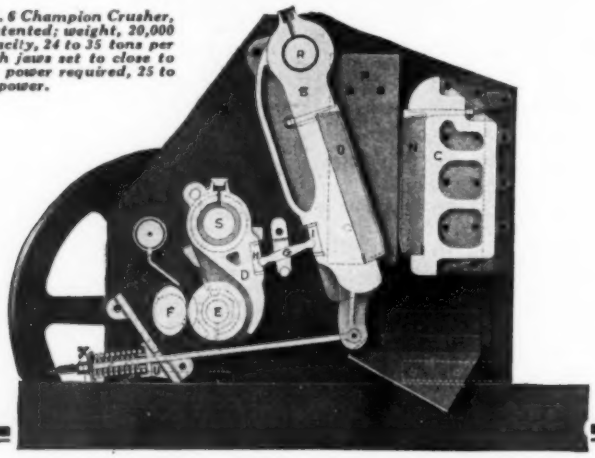
GASOLINE PUMPING ENGINES
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*Waldo Bros. & Bond Co. Boston, Mass.
*Worthington Pump & Mchy. Corp., New York.
American Well-Works, Aurora, Ill.

GASOLINE STORAGE TANKS
*Bowser & Co., Inc., S. F., Fort Wayne, Ind.
*Littleford Bros., Cincinnati, O.
*United Iron Works, Kansas City, Mo.
Biggs Boiler Works, Akron, Ohio.
Byers Mach. Co., J. F., Ravenna, Ohio.
Wayne Oil Tank & Pipe Co., Fort Wayne, Ind.

GATES, SLUICE
*Coldwell, Wilcox Co., Newburgh, N. Y.
*Columbian Iron Works, Chattanooga, Tenn.
*Crane Co., Chicago, Ill.
*Eddy Valve Co., Waterford, N. Y.
*Flower Valve Co., Detroit, Mich.
*Kennedy Valve Mfg. Co., Elmira, N. Y.
*Ludlow Valve Mfg. Co., Troy, N. Y.
*Rensselaer Valve Co., Troy, N. Y.
*Wood Co., R. D., Philadelphia, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Boston, Mass.
Hardesty Mfg. Co., R., Denver, Col.

GAUGES, WATER
*Clow & Sons, J. B., Chicago, Ill.
American Injector Co., Detroit, Mich.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Ashton Valve Co., Boston, Mass.
Bristol Co., Waterbury, Conn.
Lunkenheimer Co., Cincinanti, O.
United States Gauge Co., New York.
Walworth Mfg. Co., Boston, Mass.

GAUGES, RECORDING, PRESSURE, STEAM
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Ashton Valve Co., Boston, Mass.
Bristol Co., Waterbury, Conn.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Fairbanks Company, New York.
Marsh & Co., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
U. S. Gauge Co., New York.



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Class Name	Size of Jaw Opening	Jaws Set to Close	Capacity in Tons Per Hour	H. P. of Engine Required	Size of Driving Pulley	Rev. per Min.	Floor Space Required	Extreme Height of Machine	Weight
	inches	inches			inches		ft. in. ft. in.	ft. in.	
3	7½x13	2	8 to 12	12	38x 8	170	4-6x 5- 6	4-7	5500
4	9 x15	2	12 to 18	15	48x 9	155	5-6x 6- 6	5-9	8800
4½	10 x20	2	16 to 24	18	50x10	150	7-0x 7- 0	6-1	12500
6	12 x26	2	24 to 35	25	60x 9½	140	6-6x 8- 6	6-2	20000
6A	13 x26	2½	26 to 38	25	60x 9½	140	6-6x 8- 7	6-2	20075
6B	14 x26	3	30 to 45	25	60x 9½	140	6-6x 8- 8	6-2	20150
6C	15 x26	3½	35 to 50	25	60x 9½	140	6-6x 8- 9	6-2	20225
66	12 x26	2	48 to 70	50	60x 9½	140	6-6x15-11	6-2	37050
66A	13 x26	2½	52 to 76	50	60x 9½	140	6-6x16- 1	6-2	37200
66B	14 x26	3	60 to 90	50	60x 9½	140	6-6x16- 3	6-2	37350
66C	15 x26	3½	70 to 100	50	60x 9½	140	6-6x16- 5	6-2	37500
20	18 x50	2	70 to 100	50 to 60	72x12½	105	11-4x 9- 4	10-0	60900
20A	19 x50	2½	80 to 110	50 to 60	72x12½	105	11-4x 9- 5	10-0	61050
20B	20 x50	3	90 to 120	50 to 60	72x12½	105	11-4x 9- 6	10-0	61200
20C	21 x50	3½	100 to 130	50 to 60	72x12½	105	11-4x 9- 7	10-0	61350
20D	22 x50	4	110 to 140	50 to 60	72x12½	105	11-4x 9- 8	10-0	61500
20E	23 x50	4½	120 to 150	60 to 70	72x12½	105	11-4x 9- 9	10-0	61650
20F	24 x50	5	130 to 160	60 to 70	72x12½	105	11-4x 9-10	10-0	61800

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GAUGES, SURFACE, RESERVOIR AND SPECIAL WATER-WORKS
*Builders Iron Foundry, Providence, R. I.
*Clark Co., H. W., Matton, Ill.
*Simplex Valve & Meter Co., Philadelphia, Pa.

GENERATORS, ELECTRIC
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Gregory Electric Co., Chicago, Ill.
Ideal Elec. & Mfg. Co., Mansfield, O.
Triumph Electric Co., Cincinnati, O.
Western Electric Co., New York.

GLASS, FIREPROOF. (See Wire Glass.)

GRADERS, ROAD
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Mchy. Co., Kennett Square, Pa.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Union Iron Prod. Co., East Chicago, Ind.
*Zieg Mfg. Co., P. B., Fredericktown, O.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Port Huron Eng. & Thresh. Co., Pt. Huron, Mich.

HAMMERS, STEAM, PILE. (See Pile Hammers, Steam.)

HEATING KETTLES
*Connery & Co., Inc., Philadelphia, Pa.
*Dyar Supply Co., Cambridge, Mass.
*Littleford Bros., Cincinnati, O.
Union Iron Works, Hoboken, N. J.

HOISTS, BELT-DRIVEN
Mundy Hoisting Engine Co., J. S., Newark, N. J.

HOIST, CONCRETE TOWER
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Ransome Conc. Mchy. Co., Dunellen, N. J.

HOISTS, CONTRACTORS', ELECTRIC
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Byers Machine Co., J. F., Ravenna, O.
Ingersoll-Rand Co., New York.
Lidgerwood Mfg. Co., New York.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.

HOISTS, CONTRACTORS', GASOLINE
*Dyar Supply Co., Cambridge, Mass.
*Waldo Bros. & Bond Co., Boston, Mass.
American Cement Mach. Co., Keokuk, Ia.
Domestic Engine & Pump Co., Shippensburg, Pa.
Lidgerwood Mfg. Co., New York.
Monighan Machine Co., Chicago, Ill.
Schramm & Son, Inc., Chris. D., Philadelphia, Pa.

HOISTS, CONTRACTORS', STEAM
*Haiss Mfg. Co., Geo., New York.
Byers Machine Co., J. F., Ravenna, O.
Flory Mfg. Co., S., Bangor, Pa.
Ingersoll-Rand Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lansing Co., Lansing, Mich.
Lidgerwood Mfg. Co., New York.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.

HOISTS, PNEUMATIC
*Worthington Pump & Mchy. Corp., New York.
Chicago Pneumatic Tool Co., Chicago, Ill.
Detroit Hoist & Machine Co., Detroit, Mich.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
Northern Engineering Works, Detroit, Mich.

HOPPERS, CONCRETE
*Koehring Mach. Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

HOSE, AIR
*Goodyear Tire & Rubber Co., Akron, O.
*U. S. Rubber Co., New York.
Cincinnati Rubber Mfg. Co., Cincinnati, O.
Cleveland Rock Drill Co., Cleveland, O.

HYDRANTS, FIRE
*Clow & Sons, J. B., Chicago, Ill.
*Columbian Iron Works, Chattanooga, Tenn.
*Eddy Valve Mfg. Co., Waterford, N. Y.
*Flower Valve Mfg. Co, Detroit, Mich.
*Glamorgan Pipe & Fdry. Co., Lynchburg, Va.
*Kennedy Valve Mfg. Co., Elmira, N. Y.
*Ludlow Valve Mfg. Co, Troy, N. Y.
*Norwood Engineering Co, Florence, Mass.
*Rensselaer Valve Co., Troy, N. Y.
*S. E. T. Valve & Hydrant Co., New York
*Smith Mfg Co., A. P., East Orange, N. J.
*Wood & Co., R. D., Philadelphia, Pa.
*Worthington Pump & Mchy. Corp., New York.
American Foundry & Mfg. Co., St. Louis, Mo.

INCINERATORS, GARBAGE
*Destructor Co., The, New York.
Stacey Bates Co., Minneapolis, Minn.

INDICATOR POSTS
*Clow & Sons, J. B., Chicago, Ill.
*Columbian Iron Works, Chattanooga, Tenn.
*Flower Valve Mfg. Co., Detroit, Mich.
*Kennedy Valve Mfg. Co., Elmira, N. Y.
*Ludlow Valve Mfg. Co., Troy, N. Y.
*Pratt & Cady, Inc., Hartford, Conn.
*Rensselaer Valve Co., Troy, N. Y.

INSPECTING LABORATORIES
*Conard & Busby, Burlington, N. J.
*Pittsburgh Testing Laboratories, Pittsburgh, Pa.
Allentown Testing Laboratories, Allentown, Pa.

INSTRUMENTS, SURVEYING
*Kolesch & Co., New York.
*Weber & Co., F., Philadelphia, Pa.
Ainsworth & Sons, Wm., Denver, Col.
Bausch & Lomb Optical Co., Rochester, N. Y.
Berger & Sons, C. L., Boston, Mass.
Brandis & Sons Mfg. Co., Brooklyn, N. Y.
Buff & Buff Mfg. Co., Boston, Mass.
Dietzgen Co., Eugene, Chicago, Ill.
Gurley, W. & L. E., Troy, N. Y.
Keuffel & Esser Co., Hoboken, N. J.
Leitz Co., A., San Francisco, Cal.
Pfister, Wm. H., Cincinnati, O.
White Co., David, Milwaukee, Wis.

INSULATING MATERIAL
*Bissell Company, F., Toledo, O.
*Carey Company, Philip, Cincinnati, O.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Continental Fibre Co., Newark, Del.
Johns-Manville Co., H. W., New York.
Magnesia Assn. of America, Philadelphia, Pa.

INSULATED WIRE AND CABLE
*General Electric Co., Schenectady, N. Y.
*Hazard Mfg. Co., Wilkesbarre, Pa.
*U. S. Rubber Co., New York.
*Simplex Wire & Cable Co., Boston, Mass.
Habirshaw Wire & Cable Mfg. Co., New York.

IRON WORK, STRUCTURAL AND ORNAMENTAL
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Allegheny Steel Co., Pittsburgh, Pa.
Belmont Iron Works, Philadelphia, Pa.
Christopher & Simpson Iron Wks., St. Louis, Mo.
Hirsch Rolling Mill Co., St. Louis, Mo.
Irving Iron Works, Long Island City, N. Y.
La Belle Iron Works, Steubenville, O.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Ryerson & Son, J. T., St. Louis, Mo.

JACKS, LIFTING
*McKiernan-Terry Drill Co., New York.
American Skein & Foundry Co., Racine, Wis.
Buda Company, Chicago, Ill.
Duff Mfg. Co., Pittsburgh, Pa.
Joyce-Cridland Co., Dayton, O.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Norton, Inc., A. O., Boston, Mass.
Swett Iron Works, A. L., Medina, N. Y.
Watson-Stillman Company, New York.

Where to Purchase

JOINTS, EXPANSION PAVING
*Barrett Company, New York.
*Carey Company, Philip, Cincinnati, O.
*Trus-Con Steel Co., Youngstown, O.
Waring-Underwood Co., Philadelphia, Pa

JOINTS, FLEXIBLE PIPE. (See Flexible Joints.)

LATH, METAL
*Truscon Steel Co., Youngstown, O.
American Rolling Mill Co., Middletown, O.
Berger Mfg. Co., Canton, O.
Consol. Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Buffalo, N. Y.
General Fireproofing Co., Youngstown, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Northwestern Expanded Metal Co., Chicago, Ill.
Wickwire-Spencer Steel Corp., Worcester, Mass.

LEAK FINDERS
*Clark & Co., H. W., Mattoon, Ill.
*Pitometer Company, New York.

LETTERS AND FIGURES, METAL
*Niagara Falls Met. Stamp. Wks., Niagara Falls, N. Y.

LIGHTS, CONTRACTORS
*General Elec. Co., Schenectady, N. Y.
Carbic Mfg. Co., Duluth, Minn.
MacLeod Co., Cincinnati, O.
Milburn Co., Alex., Baltimore, Md.
Prest-O-Lite Co., Inc., Indianapolis, Ind.

LIGHTING STANDARDS
*Clow & Sons, J. B., Chicago, Ill.
*Cutter Co., Geo., South Bend, Ind.
*Electric Railway Equip. Co., Cincinnati, O.
*King Mfg Co., St. Joseph, Mo.
*Stewart Iron Works, Cincinnati, O.
*Union Metal Mfg. Co., Canton, O.

LIQUID CHLORINE
*Arnold Hoffman & Co., New York.
*Electro Bleaching Gas Co., New York.
*Hook Electrochemical Co., New York.
*Penna. Salt Mfg. Co., Philadelphia, Pa.

LOADERS, GRAVEL
*Dyar Supply Co., Cambridge, Mass.
*Haiss Mfg. Co., Geo., New York.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Bay City Dredge Works, Bay City, Mich.
Lee Loader & Body Co., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Portable Mchy. Co., Passaic, N. J.
Sauerman Bros., Chicago, Ill.
Smith Company, T. L., Milwaukee, Wis.

LOCK BAR STEEL PIPE
*East Jersey Pipe Co., New York

LOCOMOTIVES, INDUSTRIAL
Baldwin Locomotive Works, Philadelphia, Pa.
Easton Car & Constr. Co., Easton, Pa.
General Equipment Co., New York.
Hoisting Mchy. Co., New York.
Koppel Industrial Car & Equip. Co., Koppel, Pa.
Machinery Sales Co., Chicago, Ill.
Marsh & Co., G. C., Chicago, Ill.
Porter Co., H. K., Pittsburgh, Pa.

LUMBER, HEAVY CONSTRUCTION
Great Southern Lumber Co., Bogalusa, La.
Industrial Lumber Co., Elizabeth, La.
Long Bell Lumber Co., Kansas City, Mo.

MANHOLE COVERS
*Bissell Co., P., Toledo, O.
*Central Foundry Co., New York.
*Lebanon Machine Co., Lebanon, N. H.
S. E. T. Valve & Hydrant Co., New York.
Sessions Foundry Co., Bristol, Conn.

METER BOXES
*Clark Co., H W., Mattoon, Ill.
*Clow & Sons, J. B., Chicago, Ill.
*Columbian Iron Works, Chattanooga, Tenn.
*Ford Meter Box Co., Wabash, Ind.
*McNutt Meter Box Co., Brazil, Ind.
*Mueller Mfg. Co., H., Decatur, Ill.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*S. E. T. Valve & Hydrant Co., New York.

METER COUPLINGS
*Clark Co., H. W., Mattoon, Ill.
*Ford Meter Box Co., Wabash, Ind.
*McNutt Meter Box Co., Brazil, Ind.
*Mueller Mfg. Co., H., Decatur, Ill.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Union Water Meter Co., Worcester, Mass.

METER TESTERS
*Buffalo Meter Co., Buffalo, N. Y.
*Clark Co., H. W., Mattoon, Ill.
*Ford Meter Box Co., Wabash, Ind.
*Mueller Mfg. Co., H., Decatur, Ill.
*National Meter Co., New York.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.

METERS, WATER & OIL
*Builders Iron Fdry. Co., Providence, R. I.
*Buffalo Meter Co., Buffalo, New York.
*Clark Co., H. W., Mattoon, Ill.
*Gamon Meter Co., Newark, N. J.
*General Elec. Co., Schenectady, N. Y.
*Hersey Mfg. Co., Boston, Mass.
*National Meter Co., New York.
*Neptune Meter Co., E. Pittsburgh, Pa.
*Pitsburgh Meter Co., E. Pittsburgh, Pa.
*Simplex Valve & Meter Co., Philadelphia, Pa.
*Thomson Meter Co., Brooklyn, N. Y.
*Union Water Meter Co., Worcester, Mass.
*Worthington Pump & Mchy. Corp., New York.

MIXERS, CONCRETE. (See Concrete Mixers.)

MIXERS, GROUT
American Cement Mchy. Co., Keokuk, Ia.
Lakewood Engineering Co., Cleveland, O.
Union Iron Works, Inc., Hoboken, N. J.

MIXERS, HOT
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Koehring Machine Co., Milwaukee, Wis.
Austin Co., Inc., F. C., Chicago, Ill.

MIXERS, MORTAR
American Cement Machine Co., Keokuk, Ia.
Austin Co., Ins., F. C., Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
Lakewood Engineering Co., Cleveland, O.
Knickerbocker Co., Jackson, Mich.
Lansing Co., Lansing, Mich.
Lakewood Engineering Co., Cleveland, Ohio.
Ransome Concrete Mchy. Co., Dunellen, N. J.
Smith Co., T. L., Milwaukee, Wis.
Standard Scale & Supply Co., Pittsburgh, Pa.

MIXERS, PAVING
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Jaeger Machine Co., Columbus, Ohio.
*Koehring Machine Co., Milwaukee, Wis.
American Cement Machine Co., Keokuk, Ia.
Austin Co., Inc., F. C., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Foote Conc. Machinery Co., Chicago, Ill.
Lakewood Engineering Co., Cleveland, O.
Smith Co., T. L., Chicago, Ill.

MOTORS
*Allis Chalmers Mfg. Co., Milwaukee, Wis.
*Dyar Supply Co., Cambridge, Mass.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Ingersoll Rand Co., New York.
Triumph Electric Co., Cincinnati, O.

MOTOR FIRE APPARATUS
*American-LaFrance Fire Eng. Co., Elmira, N. Y.
*Childs Mfg. Co., O. J., Utica, N. Y.

MOTOR TRUCKS (See Trucks, Motor)

MOULDS, CONCRETE
Blaw-Knox Co., Pittsburgh, Pa.
Hydraulic Pressed Steel Co., Cleveland, O.

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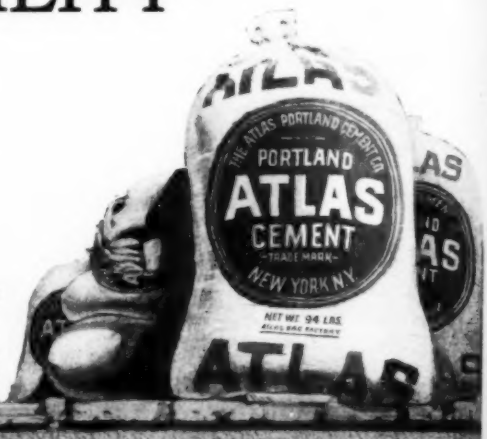

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Public Service Properties — Refrigeration
Industrial and Textile Plants — Municipal Improvements

Where to Purchase

OIL ENGINES
- ***Allis-Chalmers Mfg. Co., Milwaukee, Wis.**
- ***Bush-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.**
- ***Fairbanks, Morse & Co., Chicago, Ill.**
- ***Foos Gas Engine Co., Springfield, O.**
- ***Nordberg Mfg. Co., Milwaukee, Wis.**
- ***Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.**
- ***Worthington Pump & Mchy. Corp., New York.**
- Advance Rumely Co., La Porte, Ind.
- Bessemer Gas Eng. Co., Grove City, Pa.
- Chicago Pneumatic Tool Co., Chicago, Ill.
- De La Vergne Machine Co., New York.
- Ingersoll-Rand Co., New York.
- International Harvester Co. of Am., Chicago, Ill.
- Machinery Sales Co., Chicago, Ill.
- Midwest Engine Co., Indianapolis, Ind.

OIL, ROAD
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- ***Standard Oil Co. of Indiana, Chicago, Ill.**
- ***Texas Company, New York.**
- Atlantic Refining Co., Philadelphia, Pa.
- Interocean Oil Co., New York.
- Pierce Oil Corp., New York.
- Standard Oil Co. of N. J., Newark, N. J.
- U. S. Asphalt Refining Co., New York.

OIL TANKS
- ***Bowser & Co., S. F., Fort Wayne, Ind.**
- ***Chicago Bridge & Iron Works, Chicago, Ill.**
- ***Connery & Co., Inc., Philadelphia, Pa.**
- ***Pacific Tank & Pipe Co., San Francisco, Cal.**
- ***Littleford Bros., Cincinnati, O.**
- ***Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.**
- ***United Iron Works, Kansas City, Mo.**
- Biggs Boiler Works Co., Akron, O.
- Fouts Co., C. C., Mildletown, O.
- Petroleum Iron Works Co., Sharon, Pa.
- Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
- Walsh & Weidner Boiler Co., Chattanooga, Tenn.

ORNAMENTAL BRASS & IRONWORK
- Newman Mfg. Co., Cincinnati, Ohio.

PACKING, WATER PIPE
- ***Leadite Co., The, Philadelphia, Pa.**
- ***Union Water Meter Co., Worcester, Mass.**
- ***United Lead Company, New York.**
- Green, Tweed & Co., New York.

PAINTS, METAL PROTECTION
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- ***Dixon Crucible Co., Jersey City, N. J.**
- ***Du Pont deNemours & Co., Inc., Wilmington, Del.**
- ***Semet-Solvay Co., Syracuse, N. Y.**
- Berry Bros., Detroit, Mich.
- Besley & Co., Chicago, Ill.
- Carbolineum Wood Preserving Co., New York.
- Cook Paint Co., Kansas City, Mo.
- Detroit Graphite Co., Detroit, Mich.
- Longman & Martinez, New York.
- Minwax Co., New York.
- Sonneborn Sons, Inc., New York.
- Toch Bros., New York.

PAPERS, BLUE PRINT AND BROWN PRINT
- Indianapolis Blue Print & Supply Co., Indianapolis, Ind.

PAPER, BUILDING, ROOFING, ETC.
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- Berlin Mills Co., Portland, Me.
- Bird & Son, E. Walpole, Mass.
- Hydrex Felt & Eng. Co., New York.
- Johns-Manville Co., H. W., New York.
- National Roofing Co., Tonawanda, N. Y.

PAVING BLOCKS, CREOSOTED WOOD
- ***Republic Creosoting Co., Youngstown, O.**
- Carbolineum Wood Preserving Co., New York.
- Jennison-Wright Co., Toledo, O.
- Wyckoff Pipe & Creosoting Co., New York.

PAVING BRICK
- ***Dee Company, Wm. E., Chicago, Ill.**
- ***Met. Paving Brick Co., Canton, O.**
- ***National Paving Brick Mfrs. Assn., Cleveland, O.**
- ***Southern Clay Mfg. Co., Chattanooga, Tenn.**

PAVING MACHINERY
- ***Austin-Western Road Mchy. Co., Chicago, Ill.**
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Buffalo-Springfield Roller Co., Springfield, O.**
- ***Erie Machine Shops, Erie, Pa.**
- ***Equitable Asphalt Main. Co., Kansas City, Mo.**
- Cummer & Son Co., F. D., Cleveland, O.
- East Iron & Machine Co., Lima, O.
- Lakewood Engineering Co., Cleveland, O.

PAVING MATERIALS
- ***Atlantic Refining Co., Philadelphia, Pa.**
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Barrett Co., New York.**
- ***Bitoslag Paving Co., New York.**
- ***Carey Co., Philip, Cincinnati, O.**
- ***Standard Oil Co. of Indiana, Chicago, Ill.**
- ***Texas Company, New York.**
- ***Warren Bros. Co., Boston, Mass.**
- Robertson Co., H. H., Pittsburgh, Pa.
- Standard Oil Co. of N. J., Newark, N. J.

PAVING TOOLS
- ***Barber Asphalt Paving Co., Philadelphia, Pa.**
- ***Connery & Co., Inc., Philadelphia, Pa.**
- ***Littleford Bros Co., Cincinnati, O.**
- ***Warren Bros. Co., Boston, Mass.**
- Anderson Tool & Sup. Co., W. H., Detroit, Mich.
- Carpenter & Co., Geo. B., Chicago, Ill.
- Kramer Bros. Fdry. Co., Dayton, O.
- Union Iron Works, Hoboken, N. J.

PERFORATED METALS
- ***Allis-Chalmers Mfg. Co., Milwaukee, Wis.**

PICKS AND SHOVELS
- ***Dyar Supply Co., Cambridge, Mass.**
- American Shovel & Stamping Co., Lorain, O.
- Ames Shovel & Tool Co., Boston, Mass.
- Carpenter Co., G. B., Chicago, Ill.
- Chisholm's Steel Shovel Works, Cleveland, O.
- Conneaut Shovel Co., Conneaut, O.
- Indiana Shovel Co., New Castle, Ind.
- Pittsburgh Shovel Co., Pittsburgh, Pa.
- Shannon & Co., J. J., Philadelphia, Pa.

PILE DRIVERS
- ***McKiernan-Terry Drill Co., New York.**
- Bucyrus Co., So. Milwaukee, Wis.
- Industrial Works, Bay City, Mich.
- Lidgerwood Manufacturing Co., New York.
- McMyler Interstate Co., Cleveland, O.
- Union Iron Works, Hoboken, N. J.

PILE HAMMERS, STEAM
- ***McKiernan-Terry Drill Co., New York.**
- Industrial Works, Bay City, Mich.
- Lidgerwood Manufacturing Co., New York.
- Union Iron Works, Hoboken, N. J.

PILING, INTERLOCKING STEEL
- Foundation Co., New York.
- Lackawanna Steel Co., Lackawanna, N. Y.
- O'Rourke Engineering Co., New York.

PIPE, CAST IRON
- ***Builders Iron Foundry, Providence, R. I.**
- ***Central Foundry Co., New York.**
- ***Clow & Sons, J. B., Chicago, Ill.**
- ***U. S. Cast Iron Pipe & Fdy. Co., Burlington, N.J.**
- ***Warren Fdry. & Machine Co., Philadelphia, Pa.**
- ***Wood & Co., R. D., Philadelphia, Pa.**
- Fox & Co., John, New York.
- Greene-Wolf Co., New York.

PIPE, CORR. METAL
- ***Newport Culvert Co., Newport, Ky.**

PIPE COVERING
- ***Carey Co., Philip, Cincinnati, O.**
- ***Pacific Tank & Pipe Co., San Francisco, Cal.**
- Magnesia Assn. of America, Philadelphia, Pa.
- Michigan Pipe Co., Bay City, Mich.
- Standard Wood Pipe Co., Williamsport, Pa.
- Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE CUTTERS. **(See Cutters, Pipe, Hand.)**

Where to Purchase

PIPE FITTINGS
*American C. I. Pipe Co., Birmingham, Ala.
*American Pipe Bending Mch. Co., Boston, Mass.
*Builders Iron Fdry. Co., Providence, R. I.
*Central Foundry Co., New York.
*Crane Co., Chicago, Ill.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
*Wood & Co., R. D., Philadelphia, Pa.
Lunkenheimer Co., Cincinnati, O.

PIPE HANDLING MACHINERY
*Mueller Mfg. Co., H., Decatur, Ill.
*Taylor Portable Steel Derrick Co., Chicago, Ill.

PIPE LEAD
*United Lead Company, New York.

PIPE JOINT COMPOUND
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Dixon Crucible Co., J., Jersey City, N. J.
*Leadite Company, Inc., Philadelphia, Pa.
*Pacific Flush Tank Co., New York.

PIPE, RIVETED STEEL
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Connery & Co., Inc., Philadelphia, Pa.
*East Jersey Pipe Corp., Paterson, N. J.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
Cambria Steel Co., Philadelphia, Pa.
Hammond Iron Works, Warren, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Tippet & Wood, Phillipsburg, N. J.

PIPE SPIRAL RIVETED
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.

PIPE, WOOD
*Pacific Tank & Pipe Co., San Francisco, Cal.
*Standard Wood Pipe Co., Williamsport, Pa.
American Wood Pipe Co., Tacoma, Wash.
Continental Pipe Mfg. Co., Seattle, Wash.
Michigan Pipe Co., Bay City, Mich.
Western Wood Pipe Pub. Bureau, Seattle, Wash.
Wyckoff & Sons Co., A., Elmira, N. Y.

PLOWS, CONTRACTORS
*Burch Plow Works, Crestline, O.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Steel Scraper Co., Sidney, O.
Bucyrus Co., South Milwaukee, Wis.
Deere & Co., Moline, Ill.
International Harvester Co., Chicago, Ill.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Moline Plow Co., Moline, Ill.
Oliver Chilled Plow Works, South Bend, Ind.
Western Wheeled Scraper Co., Aurora, Ill.

PLUMBING SUPPLIES
*Clow & Sons, J. B., Chicago, Ill.
*Mueller Mfg. Co., H., Decatur, Ill.
*Rundle Spence Mfg. Co., Milwaukee, Wis.
Glauber Brass Mfg. Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

POLES, FLAG.
*Electric Railway Equipment Co., Cincinnati, O.

POLES, STEEL STRUCTURAL
*Electric Railway Equipment Co., Cincinnati, O.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Lea-Courtney Co., Newark, N. J.
Manistee Iron Works, Manistee, Mich.
Morris Machine Works, Baldwinsville, N. Y.

PORTABLE STEEL DERRICKS. (See Derricks, Steel Portable.)

PORTLAND CEMENT. (See Cement.)

POWDER. (See Explosives.)

PUMPS, AIR LIFT
*Indiana Air Pump Co., Indianapolis, Ind.
*Worthington Pump & Mchy. Corp., New York.
Advance Pump & Compr. Co., Battle Creek, Mich.
American Steam Pump Co., Battle Creek, Mich.
Cameron Steam Pump Works, A. S., New York.
Emerson Pump & Valve Co., Alexander, Va.
Ingersoll-Rand Co., New York.
McGowan Co., Cincinnati, O.
Schramm & Son, Chris. D., Philadelphia, Pa.
Sullivan Machinery Co., Chicago, Ill.
Union Steam Pump Co., Battle Creek, Mich.

PUMPS, BOILER FEED
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., E. Trenton, N. J.
*Deming Co., Salem, O.
*Fairbanks, Morse & Co., Chicago, Ill.
*Indiana Air Pump Co., Indianapolis, Ind.
*Yeomans Bros. Co., Chicago, Ill.
Advance Pump & Compr. Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Goulds Mfg. Co., Seneca Falls, N. Y.
Murray Iron Works, Burlington, Ia.
Scranton Pump Co., Scranton, Pa.
Vogt Bros. Mfg. Co., Louisville, Ky.
Warren Steam Pump Co., Warren, Mass.

PUMPS, CENTRIFUGAL. (See Centrifugal Pumps.)

PUMPS, CONTRACTORS'
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Deming Co., Salem, O.
*Waldo Bros. & Bond Co., Boston, Mass.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Emerson Pump & Valve Co., Alexandria, Va.
Lea-Courtenay Co., Newark, N. J.
McGowan Co., J. H., Cincinnati, O.
Schramm & Son, Inc., Chris. D., Philadelphia, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.

PUMPS, DEEP WELL
*Deming Co., Salem, O.
*Fairbanks, Morse & Co., Chicago, Ill.
*Indiana Air Pump Co., Chicago, Ill.
*Cook, A. D., Lawrenceburg, Ind.
*United Iron Works, Kansas City, Mo.
Aldrich Pump Co., Allentown, Pa.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Keystone Driller Co., Beaver Falls, Pa.
Layne & Bowler Co., Memphis, Tenn.

PUMPS, DIAPHRAGM
*Deming Co., Salem, O.
*Dyar Supply Co., Cambridge, Mass.
*Fairbanks, Morse & Co., Chicago, Ill.
*Waldo Bros. & Bond Co., Boston, Mass.
*Worthington Pump & Mchy. Corp., New York.
Advance Pump & Comp. Co. Battle Creek, Mich.
Barnes Mfg. Co., Mansfield, O.
Carpenter & Co., Chicago, Ill.
Domestic Engine & Pump Co., Shippensburg, Pa.
Lawrence Machine Co., Lawrence, Mass.
Manistee Iron Works, Manistee, Mich.
Rumsey Pump Co., Ltd., Seneca Falls, N. Y.
Standard Scale & Supply Co., Pittsburgh, Pa.
Topping Bros., New York.

PUMPS, DREDGING
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Wood & Co., R. D., Philadelphia, Pa.
*Worthington Pump & Mchy. Corp., New York.
Adrich Pump Co., Allentown, Pa.
American Well Works, Aurora, Ill.
Buffalo Steam Pump Works, Buffalo, N. Y.
Domestic Eng. & Pump Co., Shippensburg, Pa.
Erie Pump & Eng. Co., Medina, N. Y.
Ingersoll-Rand Co., New York.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.
Rumsey Pump Co., Ltd., Seneca Falls, N. Y.

PUMPS, GASOLINE AND OIL
*Bowser & Co., S. F., Fort Wayne, Ind.

Where to Purchase

PUMPS, POWER
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*Deming Co., Salem, O.
*Fairbanks, Morse & Co., Chicago, Ill.
*Indiana Air Pump Co., Indianapolis, Ind.
*Koehring Machine Co., Milwaukee, Wis.
*United Lead Company, New York.
*Worthington Pump & Machy. Corp., New York.
*Yeomans Bros., Chicago, Ill.
Alamo Iron Works, San Antonio, Tex.
American Steam Pump Co., Battle Creek, Mich.
American Well Works, Aurora, Ill.
Blake-Knowles Works, New York.
Gardner Governor Co., Quincy, Ill.
Domestic Eng. & Pump Co., Shippensburg, Pa.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Ingersoll-Rand Co., New York.
McGowan Co., Cincinnati, O.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Platt Iron Works, Dayton, O.

RAIL AND RAIL JOINTS
*Zelnicker Supply Co., W., St. Louis, Mo.
Bethlehem Steel Co., Bethlehem, Pa.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Easton Car & Constn. Co., New York.
Hirsch Rolling Mill Co., St. Louis, Mo.
Lackawanna Steel Co., Lackawanna, N. Y.

RAILROAD DITCHERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
American Hoist & Derrick Co., St. Paul, Minn.
Ball Engine Co., Erie, Pa.
Buckeye Traction Ditcher Co., Findlay, O.
Byers Machine Co., J. F., Ravenna, O.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.
Thew Automatic Shovel Co., Lorain, O.

RECORDERS, WATER STAGE
*Builders Iron Fdry., Providence, R. I.
*Gurley, W. & L. E., Troy, N. Y.

REINFORCING CONCRETE. (See Concrete Reinforcements.)

RIVETERS, PORTABLE PNEUMATIC
Alliance Machine Co., Alliance, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Hanna Eng. Works, Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ryerson & Son, J. T., Chicago, Ill.
Watson-Stillman Co., New York.

RIVETS, BRIDGE AND STRUCTURAL. (See Bolts, Nuts, Etc.)

ROAD OILERS
*Autocar Co., Ardmore, Pa.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Four Wheel Drive Auto Co., Clintonville, Wis.
*Good Roads Machinery Co., Kennett Square, Pa.
*Selden Truck Corpn., Rochester, N. Y.
*Service Motor Truck Co., Wabash, Ind.
*Universal Road Mchy. Co., Kingston, N. Y.
*White Co., Cleveland, O.
Huber Mfg. Co., Marion, O.

ROAD ROLLERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co., Springfield, O.
*Erie Machine Shops, Erie, Pa.
*Good Roads Machinery Co., Kennett Square, Pa.
*Universal Road Mchy. Co., Kingston, N. Y.

ROAD AND STREET MACHINERY
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co, Springfield, O.
*Connery & Co., Inc., Philadelphia, Pa.
*Erie Machine Shops, Erie, Pa.
*Good Roads Machinery Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Kinney Mfg. Co., Boston, Mass.
*Koehring Machine Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Union Iron Prod. Co., East Chicago, Ind.
*United Iron Works, Kansas City, Mo.
*Universal Road Mchy. Co., Kingston, N. Y.
*Zieg Mfg. Co., F. B., Fredericktown, O.
Lakewood Engineering Co., Cleveland, O.

ROCK CRUSHERS
*Allis-Chalmers Mfg. Co. Milwaukee, Wis.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Universal Road Machinery Co., Kingston, N. Y.
*Worthington Pump & Mchy. Corp., New York.
Acme Road Mchy. Co., Frankfort, N. Y.
Chalmers & Williams, Inc., Chicago Heights, Ill.
Fuller Lehigh Co., Fullerton, Pa.
Galion Iron Works Mfg. Co., Galion, O.
Jeffrey Mfg. Co., Columbus, O.
Link Belt Co., Philadelphia, Pa.
McLanahan-Stone Mchy. Co., Hollidaysburg, Pa.
Raymond Bros. Impact Pulv. Co., Chicago, Ill.
Schramm & Son, Chris. D., Philadelphia, Pa.
Smith Co., T. L., Chicago, Ill.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Williams Patent Crusher & Pulv. Co., Chicago, Ill.

ROOFING KETTLES
*Barber Asphalt Paving Co., Philadelphia, Pa.

ROOFING MATERIALS
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Barrett Co., New York.
*Carey Mfg. Co., Philip, Cincinnati, O.
*Standard Oil Co. of Indiana, Chicago, Ill.
*Texas Co., New York.
*Truscon Steel Co., Youngstown, Ohio.
Berger Mfg. Co., Canton, Ohio.
Bird & Son, East Walpole, Mass.
Johns-Manville Co., H. W., New York.
Sonneborn Sons, Inc., L., New York.
Stark Rolling Mill Co., Canton, O.

ROPE, MANILA
American Mfg. Co., Brooklyn, New York.
Broderick & Bascom Rope Co., St. Louis, Mo.
Carpenter & Co., Geo. B., Chicago, Ill.
Columbian Rope Co., Auburn, N. Y.
Peoria Cordage Co., Peoria, Ill.
Plymouth Cordage Co., N. Plymouth, Mass.
Upson-Walton Co., Cleveland, O.
Waterbury Co., New York.

ROPE, WIRE, HOISTING, HAULAGE
*American Steel & Wire Co., Chicago, Ill.
Broderick & Bascom Rope Co., St. Louis, Mo.
Clinton-Wright Co., Worcester, Mass.
Macomber & Whyte, Kenosha, Wis.
Roebling's Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.
Waterbury Co., New York.

SASH, ROLLED STEEL
Lupton Sons Co., David, Philadelphia, Pa.

SAW RIGS, PORTABLE
C. H. & E. Mfg. Co., Milwaukee Wis.
Knickerbocker Co., Jackson, Mich.

SCARIFIERS
*Austin Western Road Mchy. Co., Chicago, Ill.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co., Springfield, O.
*Good Roads Mchy. Co., Kennett Square, Pa.
*Lyle Cul. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Mchy. Co., Kingston, N. Y.
Acme Road Mchy. Co., Frankfort, N. Y.
Galion Iron Works & Mfg. Co., Galion, O.
Huber Mfg. Co., Marion, O.

SCRAPERS, DRAG
Smith Co., T. L., Chicago, Ill.

SCRAPERS, ROAD
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, O.
*Good Roads Mchy. Co., Kennett Square, Pa.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Co., Minneapolis, Minn.
*Zieg Mfg. Co., F. B., Fredericktown, O.
Acme Road Mchy. Co., Frankfort, N. Y.
East Iron & Machine Co., Lima, O.
Galion Iron Works & Mfg. Co., Galion, O.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Sidney Steel Scraper Co., Sidney, O.

** Indicates that the manufacturer carries an advertisement. See index facing inside back cover.*

Where to Purchase

SCRAPERS, SELF-LOADING
*Baker Manufacturing Co., Springfield, Ill.

SCREENS, SAND, GRAVEL AND COAL
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, O.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Bartlett & Snow Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Clinton-Wright Wire Co., Worcester, Mass.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
New Jersey Wire Cloth Co., Trenton, N. J.
Sackett Screen & Chute Co., H. B., Chicago, Ill.
Waterloo Cement Machinery Corp., Waterloo, Ia.
Webster Mfg. Co., Tiffin, O.

SCREEN, SEWER
*Pacific Flush Tank Co., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.

SCREWS
St. Louis Screw Co., St. Louis, Mo.

SEWAGE PUMPS AND EJECTORS
*Otterson Auto Eductor Co., Springfield, O.
*Pacific Flush Tank Co., Chicago, Ill.
*Yeoman Bros. Co., Chicago, Ill.
Walworth Mfg. Co., Boston, Mass.

SEWER BLOCKS, SEGMENT
*McNutt Meter Box Co., Brazil, Ind.
American Sewer Pipe Co., Akron, O.
Blackmer & Post Pipe Co., St. Louis, Mo.
Chicago Reinforced Conc. Pipe Co., Chicago, Ill.

SEWER CLEANING APPARATUS
*Champion Corporation, Hammond, Ind.
*Healey, P. J., New York.
*Pacific Flush Tank Co., New York.
*Thompson-Fleming Co., Inc., Buffalo, N. Y.
*Turbine Sewer Machine Co., Milwaukee, Wis.

SEWER PIPE
*Dee Company, Wm. F., Chicago, Ill.
*Pacific Tank & Pipe Co., San Francisco, Cal.
American Sewer Pipe Co., Akron, O.
Blackmer & Post Pipe Co., St. Louis, Mo.

SEWER RODS
*Bissell Co., F., Toledo, O.
*Champion Corpn., Hammond, Ind.

SHOVELS, ELECTRIC
Ball Engine Co., Erie, Pa.
Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.
Thew Automatic Shovel Co., Lorain, O.

SHOVELS, GASOLINE
American Steel Dredge Co., Fort Wayne, Ind.
Ball Engine Co., Erie, Pa.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.
Thew Automatic Shovel Co., Lorain, O.

SHOVELS, STEAM
American Clay Mch. Co., Bucyrus, O.
American Steel Dredge Co., Fort Wayne, Ind.
Ball Engine Co., Erie, Pa.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, O.
Fairbanks Steam Shovel Co., Marion, O.
Industrial Works, Bay City, Mich.
Keystone Driller Co., Beaver Falls, Pa.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.
Thew Automatic Shovel Co., Lorain, O.
Toledo Foundry & Machine Co., Toledo, O.

SIGNS, STREET AND ROAD
*Baltimore Enamel & Novelty Co., Baltimore, Md.
*Enameled Iron Sign Co., New York.
*Lebanon Machine Co., Lebanon, N. H.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Stewart Iron Works Co., Chicago, Ill.
*Thompson-Fleming Co., Inc., Buffalo, N. Y.
*Union Iron Products Co., East Chicago, Ind.

SLEEVES, TAPPING AND VALVES
*Flower Valve Mfg. Co., Detroit, Mich.
*Kennedy Valve Co., Elmira, N. Y.
*Mueller Mfg. Co., Decatur, Ill.
*Rensselaer Valve Co., Troy, N. Y.
*Smith Mfg. Co., A. P., East Orange, N. J.

SLUICE GATES. (See Gates, Sluice.)

SNOW CLEANING MACHINERY
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Machinery Co., Kennett Square, Pa.
*Owensboro Ditcher & Grader Co., Owensboro, Ky.
*Zieg Mfg. Co., Fredericktown, O.

SPREADERS, STONE
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Burch Plow Works, Crestline, O.

SPRINKLERS AND SWEEPERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Autocar Co., Ardmore, Pa.
*Elgin Sales Co., New York.
*Federal Motor Truck Co., Detroit, Mich.
*Four Wheel Drive Auto Co., Clintonville, Wis.
*Good Roads Mchy. Co., Kennet Square, Pa.
*Municipal Supply Co., South Bend, Ind.
*Rochester Can Co., Rochester, N. Y.
*Service Motor Truck Co., Wabash, Ind.
*Thompson-Fleming Co., Inc., Buffalo, N. Y.
*Tiffin Wagon Co., Tiffin, O.
*Universal Road Mchy. Co., Kingston, N. Y.
*White Company, Cleveland, O.
Etnyre & Co., E. D., Oregon, Ill.

STANDPIPE, TANKS AND TOWERS
*Caldwell Co., Louisville, Ky.
*Chicago Bridge & Iron Works, Chicago, Ill.
*Connery & Co., Philadelphia, Pa.
*Fairbanks, Morse & Co., Chicago, Ill.
*Pacific Tank & Pipe Co., San Francisco, Cal.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
*United Iron Works Co., Kansas City, Mo.
*Zelnicker Supply Co., Walter A., St. Louis, Mo.
Blaw-Knox Co., Pittsburgh, Pa.
Chattanooga Blr. & Tank Co., Chatatnooga, Tenn.
Petroleum Iron Works, Sharon, Pa.
Walsh & Weidner Boiler Co., Cnattanooga, Tenn.

STEAM TURBINES
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*DeLaval Steam Turbine Co., Trenton, N. J.

STEEL PLATE CONSTRUCTION
*Chicago Bridge & Iron Works, Chicago, Ill.
*Littleford Bros., Cincinnati, O.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
Bethlehem Steel Bridge Co., Bethlehem, Pa.
Birmingham Steel Corp., Birmingham, Ala.
Blaw-Knox Co., Pittsburgh, Pa.
Heltzel Steel Form & Iron Co., Warren, O.
McClintic-Marshall Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Toledo Bridge & Crane Co., Toledo, O.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Jersey City, N. J.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STREET LAMPS
*Cutter Company, Geo., South Bend, Ind.
*Electric Railway Equipment Co., Cincinnati, O.
*General Elec. Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
King Mfg Co., St. Joseph, Mo.
Union Metal Mfg Co., Canton, O.

STREET AND ROAD SIGNS. (See Signs, Street and Road.)

STREET SWEEPERS. (See Sprinklers and Sweepers.)

STRUCTURAL, STEEL AND IRON
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa
American Bridge Co., New York.
Belmont Iron Works, Philadelphia, Pa.
Bethlehem Steel Bridge Co., Bethlehem, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Lackawanna Steel Co., Lackawanna, N. Y.
Lakewood Engineering Co., Cleveland, O.
McClintic-Marshall Co., Pittsburgh, Pa.
Virginia Bridge & Iron Co., Roanoke, Va.
Wisconsin Bridge & Iron Co., N. Milwaukee, Wis.

Where to Purchase

STUMP PULLERS
Bennett & Co., H. L., Westerville, O.
Carpenter & Co., Geo. B., Chicago, Ill.
Clyde Iron Works, Duluth, Minn.
Hercules Mfg. Co., Centerville, Ia.
Lewis & Valentine, Roslyn, L. I.
Thomas Elevator Co., Chicago, Ill.

SURVEYORS' INSTRUMENTS. (See Instruments, Surveying.)

TABLES AND BOARDS, DRAWING. (See Drawing Materials.)

TAMPING MACHINES
*Pawling & Harnishfeger Co., Milwaukee, Wis.

TANKS, AIR COMPRESSOR
*Chicago Bridge & Iron Works, Chicago, Ill.
*Connery & Co., Inc., Philadelphia, Pa.
*Indiana Air Pump Co., Indianapolis ,Ind.
*Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.
*Worthington Pump & Machy. Corp., Ney York.
Abendroth & Root Mfg. Co., New York.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Works, Sharon, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.
Schramm & Son, Chris. D., Philadelphia, Pa.
Westinghouse Tract. Brake Co., Wilmerding, Pa.

TANKS, OIL. (See Oil Tanks.)

TANKS, WOOD AND STEEL
*Caldwell & Co., E., Louisville, Ky.
*Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros., Cincinnati, O.
*Pacific Tank & Pipe Co., San Francisco, Cal.
Eagle Tank Company, Chicago, Ill.
Hauser-Stander Tank Co., Cincinnati, O.
Stearns Lumber Co., A. T., Boston, Mass.
Western Wood Pipe Pub. Bureau, Seattle, Wash.

TAPES, STEEL AND METALLIC
*Kolesch & Co., New York.
Dietzgen Co., Eugene, New York.
Gurley, W. & L. E., Troy, N. Y.
Hamilton Mfg. Co., Two Rivers, Wis.
Keuffel & Esser Co., New York.
Lufkin Rule Co., Saginaw, Mich.

TAR
*Barrett Co., New York.

TAR KETTLES
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Connery & Co., Philadelphia, Pa.
*Dyar Supply Co., Cambridge, Mass.
*Good Roads Machinery Co., Kennett Square, Pa.
*Littleford Bros., Cincinnati, O.
MacLeod Co., Cincinnati, O.

TIES, STEEL
*International Steel Tie Co., Cleveland, O.

TIRES, RUBBER
*Dayton Rubber Mfg. Co., Dayton, O.
*Firestone Tire & Rubber Co., Akron, O.
*Goodrich Rubber Co., B. F., Akron, O.
*Goodyear Tire & Rubber Co., Akron, O.
*Kelly Springfield Tire Co., New York.
*U. S. Tire Co., New York.

TOOLS, CONTRACTORS
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Dyar Supply Co., Cambridge, Mass.

TOOL HOUSES, PORTABLE STEEL
*Littleford Bros., Cincinnati, O.

TOWERS (See Standpipe Tanks and Towers)

TRACKS, INDUSTRIAL AND PORTABLE
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constn. Co., New York.
Lakewood Engineering Co., Cleveland, O.

TRACTORS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*American La France Fire Eng. Co., Elmira, N. Y.
*Fairbanks, Morse & Co., Chicago, Ill.
*Four Wheel Drive Auto Co., Clintonville, Wis.
*Selden Truck Corpn., Rochester, N. Y.
*Service Motor Truck Co., Wabash, Ind.
*Watson Products Corp., Canastota, N. Y.
*White Company, The, Cleveland, O.
Advance-Rumely Thresher Co., Laporte, Ind.
Huber Mfg. Co., Marion, O.
Oliver Tractor Co., Knoxville, Tenn.

TRAILERS
*Eagle Wagon Works, Auburn, N. Y.
*Watson Products Corp., Canastota, N. Y.
Chase Fdry. & Supply Co., Columbus, O.
Electric Wheel Co., Quincy, Ill.
Lakewood Engineering Co., Cleveland, O.
Troy Wagon Works, Troy, O.

TRANSFORMERS
*General Electric Co., Schenectady, N. Y.
*Kuhlman Electric Co., Bay City, Mich.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

TRANSIT AND LEVELS
*Kolesch & Co., New York.
Ainsworth & Sons, Wm., Denver, Col.
Berger & Sons Co., C. L., Boston, Mass.
Buff & Buff Mfg. Co., Boston, Mass.
Gurley, W. & L. E., Troy, N. Y.
Keuffel & Esser, Hoboken, N. J.

TRANSMISSION MACHINERY POWER
*General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link Belt Co., Chicago, Ill.

TREAD, SAFETY
Concrete Steel Co., New York.
Irving Iron Works, Long Island City.

TRUCKS, MOTOR
*America-LaFrance Fire Eng. Co., Elmira, N. Y.
*Autocar Co., Ardmore, Pa.
*Couple Gear Fght. Wheel Co., Gr. Rapids, Mich.
*Federal Motor Truck Co., Detroit, Mich.
*Four Wheel Drive Auto Co., Clintonville, Wis.
*International Motor Co., New York.
*Packard Motor Car Co., Detroit, Mich.
*Selden Truck Corpn., Rochester, N. Y.
*Service Motor Truck Co., Wabash, Ind.
*Tiffin Wagon Co., Tiffin, O.
*Watson Products Corp., Canastota, N. Y.
*White Company, Cleveland, O.
Acme Motor Truck Co., Cadillac, Mich.
Brockway Motor Truck Co., Cortland, N. Y.
Clydesdale Motor Truck Co., Clyde, O.
Garford Motor Truck Co., Lima, O.
Gramm Bernstein Motor Truck Co., Lima, O.
Kissel Motor Car Co., Hartford, Wis.
Nash Motors Co., Kenosha, Wis.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Republic Motor Truck Co., Alma, Mich.
Sterling Motor Truck Co., Milwaukee, Wis.
Stewart Motor Corp., Buffalo, N. Y.
U. S. Motor Truck Co., Cincinnati, O.

TURBINES
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

UNDERPINNING
Foundation Company, New York.
O'Rourke Engineering & Constn. Co., New York.
Smith, Hauser & MacIsaac, Inc., New York.
Underpinning & Foundation Co., New York.

VALVES
*Clow & Sons, J. B., Chicago, Ill.
*Coldwell-Wilcox Co., Newburgh, N. Y.
*Crane Company, Chicago, Ill.
*Eddy Valve Co., Waterford, N. Y.
*Flower Valve Mfg. Co., Detroit, Mich.
*Kennedy Valve Mfg Co., Elmira, N. Y.
*Ludlow Valve Co., Troy, N. Y.
*Mueller Mfg. Co., H., Decatur, Ill.
*Norwood Engineering Co., Florence, Mass.

Where to Purchase

*Pratt & Cady Co., Inc., Hartford, Conn.
*Rensselaer Valve Co., Troy, N. Y.
*S. E. T. Valve & Hydrant Co., New York.
*Smith Mfg. Co., A. P., East Orange, N. J.
*Union Water Meter Co., Worcester, Mass.
*Wood & Co., R. D., Philadelphia, Pa.
Cleveland Rock Drill Co., Cleveland, O.
Glauber Brass Mfg. Co., Cleveland, O.
Golden-Anderson Valve Spec. Co., Pittsburgh, Pa.
Lunkenheimer Co., Cincinnati, O.

VALVE BOXES AND HOUSINGS

*Clark Co., H. W., Mattoon, Ill.
*Clow & Sons, J. B., Chicago, Ill.
*Columbian Iron Works, Chattanooga, Tenn.
*Eddy Valve Co., Waterford, N. Y.
*Flower Valve Mfg. Co., Detroit, Mich.
*Kennedy Valve Mfg. Co., Elmira, N. Y.
*Ludlow Valve Co., Troy, N. Y.
*Mueller Mfg. Co., H., Decatur, Ill.
*Pratt & Cady Co., Inc., Hartford, Conn.
*Rensselaer Valve Co., Troy, N. Y.
*S. E. T. Valve & Hydrant Co., New York.
*Smith Mfg. Co., A. P., East Orange, N. J.
*U. S. C. Ir. Pipe & Fdry. Co., Burlington, N. J.
*Wood & Co., R. D., Philadelphia, Pa.

VENTILATORS

Milwaukee Corrugating Co., Milwaukee, Wis.

WAGONS

*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Tiffin Wagon Co., Tiffin, O.
*Watson Products Corp., Canastota, N. Y.
*White Company, The, Cleveland, O.
Eagle Wagon Works, Auburn, N. Y.
Troy Wagon Works, Troy, O.
Western Wheeled Scraper Co., Aurora, Ill.

WAGON LOADERS

*Dyar Supply Co., Cambridge, Mass.
*Haiss Mfg. Co., New York.
Portable Mach. Co., Passaic, N. J.
Sackett Screen & Chute Co., H. B., Chicago, Ill.

WALL TIES

*Niagara Falls Met. Stamp. Wks., Niagara Falls.
Berger Mfg. Co., Canton, O.
Milwaukee Corrugating Co., Milwaukee, Wis.

WATER MAIN CLEANING

*National Water Main Cleaning Co., New York.

WATER MAIN TAPPING MACHINES

*Mueller Mfg. Co., E., Decatur, Ill.

WATER METERS. (See Meters, Water and Oil.)

WATERPROOFING COMPOUNDS AND MATERIAL

*Barber Asphalt Paving Co., Philadelphia, Pa.
*Barrett Company, New York.
*Carey Company, Philip, Cincinnati, O.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
Carbolineum Wood Preserving Co., New York.
Sonneborn Sons, Inc., New York.
Toch Brothers, New York.

WATER PURIFICATION

*Electro Bleaching Gas Co., New York.
*Hooker Electrochemical Co., New York.
*Mathieson Alkali Works, Inc., New York.
*Norwood Eng. Co., Florence, Mass.
*Penna. Salt Mfg. Co., Philadelphia, Pa.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
*R. U. V. Company, New York.
*Wallace & Tiernan Co., Inc., New York.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.

WATER REGULATORS

*Builders Iron Foundry, Providence, R. I.
*Mueller Mfg. Co., Decatur, Ill.
*Pacific Flush Tank Co., New York.
*Union Water Meter Co., Worcester, Mass.

WATER SOFTENERS

*N. Y. Continental Jewell Filter Co., Nutley, N. J.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
Arnold, Hoffman & Co., New York.
International Filter Co., Chicago, Ill.
Permutit Company, New York.
Refinite Co., Omaha, Neb.
Roberts Filter Mfg. Co., Derby, Pa.
Scaife & Sons, W. B., Pittsburgh, Pa.

WATER WHEELS

*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Leffel & Co., Jas., Springfield, O.
Pelton Water Wheel Co., San Francisco, Cal.
Smith Company, S., Morgan, York, Pa.

WELDING APPARATUS

*General Electric Co., Schenectady, N. Y.
Milburn Company, Alex., Baltimore, Md.
Oxweld Acetylene Co., Newark, N. J.

WELL-DRILLING MACHINES

American Well Works, Aurora, Ill.
Keystone Driller Co., Beaver Falls, Pa.
Star Drilling Machine Co., Akron, O.

WHEELBARROWS

*Dyar Supply Co., Cambridge, Mass.
Sidney Steel Scraper Co., Sidney, O.
Toledo Wheelbarrow Co., Toledo, O.

WINDOWS, ROLLED STEEL

Lupton Sons, David, Philadelphia, Pa.

WIRE AND CABLE. (See Cables.)

*American Steel & Wire Co., Chicago, Ill.
*Habirshaw Elec. Cable Co., Inc., N. Y. C.
*Hazard Mfg. Co., Wilkesbarre, Pa.
*Simplex Wire & Cable Co., Boston, Mass.
Roebling's Son Co., J. A., Trenton, N. J.
Waterbury Co., New York.

WIRE GLASS

Mississippi Wire Glass Co., New York.

WIRE MESH REINFORCEMENT

Wickwire-Spencer Steel Corpn., Worcester, Mass.

WOOD PESERVATIVES

*Barrett Company, New York.
*Republic Creosoting Co., Indianapolis, Ind.
Carbolineum Wood Preserving Co., New York.
Ohio Wood Preserving Co., Pittsburgh, Pa.

WRENCHES

Greene, Tweed & Co., New York.
Lowell Wrench Co., Worcester, Mass.

YOUR CO-OPERATION NEEDED

It is our desire to make the above list a complete and reliable one. In case you are using any material or equipment in your work which you do not find listed here, we would appreciate your informing us about it.

CONTRACTORS' & ENGINEERS' PURCHASING GUIDE
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MONTHLY NEWS AND CLASSIFIED LISTS OF MACHINERY AND SUPPLIES FOR CONTRACTORS, ENGINEERS AND OTHER PURCHASERS OF CONSTRUCTION EQUIPMENT

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EDITORIAL

Contractors' & Engineers'
Purchasing Guide

New York May, 1920

Machines Replace Men on Lincoln Highway Work

The Careful Choice of Contractor's Equipment Expedites Work and Saves Labor

By Thomas L. Murphy
Engineer, J. J. Dunegan Construction Company, Shenandoah, Ia.

IN doing highway paving work a contractor is confronted with many problems altogether foreign to the city paving contractor. Among these are: the securing and holding of labor on work several miles from town; the transportation of men to and from their places of living; the transportation of material from the unloading point to the spot where it is needed; deciding on a method of obtaining a supply of water and delivering it to mixers and other machines along the line of work. Needless to say, a great variety of equipment is essential.

The portion of the paving of the Lincoln Highway by the J. J. Dunegan Company, General Contractors, Shenandoah, Ia., is composed of Sections 15, 17 and H in Whitestone County, Illinois—in all about 14 miles of roadway. With the exception of some 1,800 lineal feet of pavement in Section H, which is 22 feet wide, the entire contract calls for paving 16 feet wide, 8 inches thick at the center of pavement, sloping to 7 inches at the sides, and a 7-foot dirt shoulder on either side.

There were a large number of reinforced concrete culverts and two good-sized concrete bridges to be built, as well as a number of small entrance culverts strung along the route at various farms. These culverts were built with small gangs of men and one-sack gasoline-operated mixers.

The rough grading to be done ahead of the paving is very light, there being only about 3,000 yards of dirt to be moved per mile. The haul, as a rule, is short, so most of our work was done with slips and wheelers. Fresnos were also used on certain classes of work. A large part of the wheeler work was done with Fordson tractors instead of stock. Four tractors, three on wheelers and one on the plow, made a good, workable gang. The tractors showed

STOCK PILES AND CEMENT SHED AT UNION GROVE

A SUBGRADER AT WORK

The blades which do the cutting can be seen just below the heavy cross-pieces. A Fordson tractor is furnishing the motive power

good results because of the fact that they travel faster than horses or mules. While it was hard to get men to drive the stock, no trouble was experienced in getting men to handle the tractors. The all-important matter is to give the tractors proper attention. The grading foreman required his chauffeurs to "check up" every two and one-half hours; that is, put in oil, gas and water and look the machine over to see that everything was all right. Teams and tractors will not work well together, so the stock worked on a separate piece of grading.

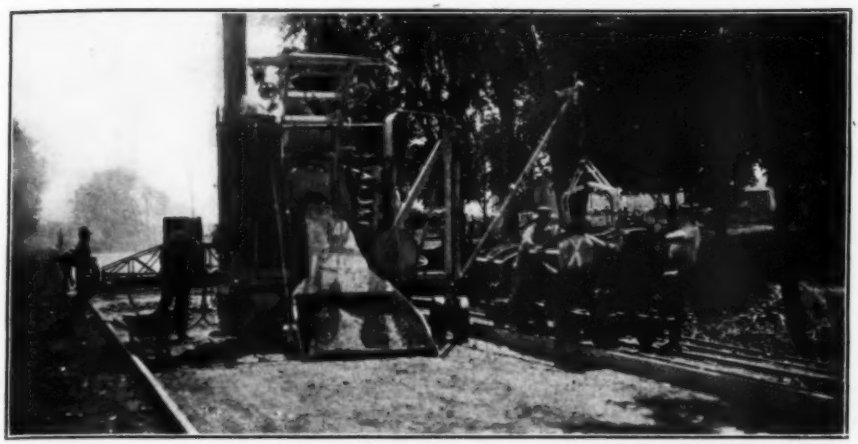
The work of finally preparing the grade ahead of the mixers is done with a Lakewood subgrader, which can be set to cut the earth to grade. This is drawn by a tractor or a roller, depending on the depth of cut. Where a small fill is required to make the bed level, men with shovels fill up the depressions from dirt on the shoulders, after which the entire grade is rolled with a 10-ton roller. This subgrading machine, while comparatively new in the contracting field, will take the place of several men and has been found a very necessary part of the construction equipment.

While the subgrading is in progress, and before the mixer comes up, the 7-inch steel side forms are placed on either side. On the present work they are set in parallel lines 16 feet apart. Great care and accuracy must be used in this work. It is imperative that they be true as to alignment and set on a solid foundation and firmly fastened down, so there will be no giving way when the finishing machine comes along. For holding the forms in place steel pedestals, made to fit this particular kind of form, are used, and are held to the ground by iron stakes. The length of each form is 12 feet, the nature of the ground determining the number of pedestals to be used. They are usually placed about 4 feet apart.

For hauling cement, sand and gravel from the station to the mixers, an industrial railroad made up of six Plymouth locomotives, eighty ¾-yard Lakewood cars and five miles of track, 24-inch gauge, was used. As a rule, there are 12 cars to the train. For loading these cars, which are divided into separate compartments for cement, sand and gravel, a tunnel on which the sand and gravel is stocked facilitates quick work. The trains are run thru this tunnel, and the sand and gravel are dumped by gravity by means of traps so placed in the roof of the tunnel that the entire train may be loaded at one stop. The trains are then run up to the cement shed, or platform, where the cement is dumped into the third compartment and started out for the mixers.

The unloading of the sand and gravel from railroad to tunnel is done with a Thew A-1 crane, using a half-yard clam shell bucket. This system of handling materials has proved very satisfactory.

Two Milwaukee three-sack mixers are used. On each mixer is a swinging crane, which takes the loaded box from the train on the industrial track laid alongside the pavement on the shoulder of the road and moves it around until it is over the skip of the mixer, when the latch holding the box is released, dumping the contents of a properly proportioned batch into the skip. As the skip is raised to discharge the batch into the mixer, the crane is swung back to be attached to another load. After a one-



FRONT VIEW OF MIXER JUST AS ONE OF THE BUCKETS HAS DUMPED ITS LOAD INTO THE THE SKIP AND IS BEING RESET ON THE INDUSTRIAL RAILROAD TRUCKS

minute mix the batch is dumped into a box on a long, swinging boom, which carries the material out to the place where it is wanted. The bottom of the box is dropped by tapping a latch on the carrier, and is automatically closed as it returns to the mixer for the next batch. One man is used to swing the boom to drop the material to best advantage, and another man with a short-handled shovel, in boots, does whatever further work is necessary to properly distribute the material.

Closely following the mixers come the Lakewood combined tamping and finishing machines, which run on top of the steel side forms. The wheels are flanged the same as those on railroad cars. The forms must be well set to hold the weight of this machine and to give traction to the wheels. The first operation is to smooth off the high spots and fill the depressions. This is accomplished with the strike-off board. Set right behind this is the tamping device, which thoroly tamps the concrete, filling all the voids and making a solid, compact slab. After this is done, or as soon as it is practicable to do so, depending on how quickly the concrete sets up, the belting apparatus is let down and put in action. This is a rubberized belt, 14 inches wide, and the length may be adjusted to suit conditions on the job. By drawing this belt back and forth over the fresh concrete, a smooth, even surface is secured. It is not possible to hand tamp and belt concrete and get a better finish than with this machine, and, besides, it takes the place of several men, a fact which in these times should not be overlooked.

On this work the specifications provide that the side forms are not to be removed within twelve hours after the concrete is placed, and, as a matter of protection to the concrete, one of two methods of covering is used. First, the concrete is covered with canvas. After the concrete has set sufficiently, the canvas must be removed and the concrete covered with earth or water. If with earth, it is covered with not less than two inches of dirt and kept watered for not less than fourteen days and left covered for not less than twenty. If the ponding or dyking method is used, the surface of the pavement is kept covered with water for two weeks. In both cases traffic is kept off for thirty days. On knolls, hills and curves where there is a superelevation, it is best for the contractor to cover the pavement with dirt, but on level surfaces the dyking system is the more economical and serves the purpose as well or better.

One very important feature of highway construction, especially on concrete work, is the matter of water-supply. On this work there were two Lakewood road pumping plants. Each plant consists of two separate pumping units mounted on one truck. Each unit consists of a triplex pump and is capable of delivering 40 gallons of water per minute with a pressure of 225 pounds

REAR VIEW OF FINISHING MACHINE. JUST TO THE LEFT CAN BE SEEN THE INDUSTRIAL RAILROAD, AND IN FRONT OF FINISHER, THE MIXING PLANT

per square inch at the pump. The pumps may be connected to supply 80 gallons per minute at the same pressure at the pump. It is advisable to use only one unit at a time, unless, of course, more water is needed, and hold the other in reserve in case of a breakdown. Thus far there has been no shut-down on this job thru the fault of the pumping plants.

To carry the water from the pumps to the line of work, we have several miles of 2-inch iron pipe, with T's and shut-off valves at various places. In stringing this pipe, it is very important to place it in such a way that there will be no low places or sags in the line where, late in the season, the water will stand and freeze over night. It is advisable to have the pipe set on fence lines or on stakes, and at certain intervals to run it low enough, by putting in a T, to drain the line whenever desired. This year it was necessary to drain the lines a number of times before the work closed; and if it had not been possible to drain the lines, the pipes would have been frozen solid and the work shut down with financial loss.

J. R. McDaniel is superintendent in charge of construction.

THE EFFECTS OF HEAVY MOTOR TRUCK TRAFFIC ON UNIMPROVED HIGHWAYS

Methods of Hauling and Laying Cast Iron or Steel Pipe

By Harry C. Ford
Engineer, Beaver Engineering and Contracting Co., New York City

Unloading

THE first matter that confronts a contractor on a pipe job is the method to be used to unload the pipes and appurtenances from cars or lighters.

If only a small amount of pipe is to be received and this pipe is less than 8 inches in diameter, the writer recommends the use of labor only, as the cost of erecting a jin pole or a derrick is too expensive. Each contractor will have to determine for himself whether he will unload pipe by hand or not. For large consignments of pipe and for pipes larger than 8 inches in diameter some method must be devised to give labor a help. Such helps consist of the jin pole and the derrick.

The contractor will have to determine which of these methods to use, and his decision should take into account the weight of the individual pieces and also the total tonnage to be unloaded. For small-size pipes up to 8 or even 12 inches in diameter the use of a jin pole and horsepower is the most economical. Also, if the total tonnage is not great, a jin pole can be used for pipes up to 20 inches, or even 24 inches, in diameter, but the use of a jin pole is not advisable for pipes of this size. After the jin pole has reached its maximum efficiency, the next step is to use a derrick. The writer has used a high breast derrick for unloading 16-inch pipe, using a yoke of oxen for power, and has obtained very satisfactory results. For pipes 24 inches in diameter or over, a power derrick or a crane should be used.

If the pipes are to be delivered to a dock and have been shipped by rail, the contractor's worries over methods of unloading are minimized, as the railroads usually deliver on derrick lighters and do their own unloading. However, if the pipe is delivered in barges, two methods are available: either erect a derrick on the dock or engage a derrick boat for unloading. The choice of methods depends upon the total tonnage to be delivered.

LOWERING 16 FEET OF 6-INCH CAST IRON PIPE INTO TRENCH BY USE OF HAND ROPES

Hauling

Before unloading the pipes the contractor must determine whether it is going to be more economical for him to use horse-drawn motor trucks, and in some cases if the haul is long, tractors, or even a narrow-gauge railroad might be considered.

The question of cost between horse-drawn vehicles and motor trucks should be given careful consideration, and in this respect the cost of upkeep of the two vehicles should be taken into account. It must also

LAYING TWO LENGTHS OF 16-INCH CAST IRON PIPE WITH PORTABLE PIPE DERRICKS. THE PIPE WAS POURED AND CAULKED ON THE BANK BEFORE THE PIPE WAS PUT INTO TRENCH

be determined whether the horse-drawn vehicle can place the pipe nearer the trench than the automobile can. In cross-country work, in many cases, it will be found that horses are more economical than motor trucks. The conditions of the roads over which the pipe is to be hauled also have a very serious bearing on a contractor's decision regarding method, as these conditions have a direct bearing on the cost of repairs, and it has been the writer's experience that motor trucks are more costly of upkeep per ton of pipe than horse-drawn vehicles. If the haul exceeds five miles the contractor has to determine whether to use a motor truck, a tractor, or a narrow-gauge railroad. The total tonnage to be hauled will have a direct bearing on which of the method is to be used.

Distributing Along the Trench

When the pipe arrives at the trench, the method of unloading must be determined. For pipes up to 20 inches in diameter hand work can be used, care being taken to protect the pipe from cracking when it is unloaded. This is accomplished by letting the end drop from the truck upon a cushion made of rope or some similar material. The writer has unloaded 48-inch pipes by hand by skidding them down on wooden skids alongside the truck, but at this time, because of the high cost of labor, it is cheaper to have some device for handling the pipe, and the writer recommends the use of a gallows. This is constructed high enough for the truck to drive under, and has a hand-power winch to raise the pipe from the truck. After the pipe has been raised, the truck drives from under the gallows, and the pipe is then lowered to the ground. Steel pipe should never be hauled on a job until it is to be laid, as the coating is more apt to be damaged than cast iron.

Excavation

The first method to be considered is excavation by hand. At this time, with labor so uncertain and expensive, this method can only be contemplated in thickly populated districts of a city, where it is impossible to use a machine. Consideration must then be given to the choice of a machine. We have the trenching machine and steam shovel to consider. The writer recommends a trenching machine for trenching not greater than 3 feet in width and down to a depth of from 16 to 20 feet. Another item to consider in excavation is the condition of the soil to be encountered. If there are many large boulders, it has been the writer's experience that the excavating machine is not economical, and he suggests the use of a steam shovel.

A steam shovel can be used where the trench runs from 2 feet in width and down

to a depth of about 9 feet, by placing a long dipper arm on the shovel. The writer used a steam shovel, with a ⅞-cubic-yard dipper for digging a trench thru decayed serpentine rock on Staten Island, with very good results. The trench was 6 feet wide and about 9 feet deep.

When a depth of 9 feet is exceeded in a trench, the contractor has to consider some other class of machinery than that described above. Fortunately, in pipe work this depth is very rarely reached. If, however, a contractor should have a contract where the trench is over 9 or 10 feet deep, he has the following machinery to pick from: cableway, trenching machine and traveling derrick. Before placing any of the above machines on the work he should figure the cost of operation, the cost of maintenance, and the cost of placing each machine on the work, together with the amount of work each machine will do.

Laying and Caulking Pipe

The writer has used several methods for laying pipe, but has always returned to the old four-legged pipe derrick as the most economical.

For pipes up to 8 inches in diameter the derrick can be discarded entirely, and the use of ropes at each end of the pipe substituted. A pipe gang with the trench open can lay these pipes about as fast as one can walk slowly along the trench. For pipes larger than 8 inches in diameter a pipe derrick is recommended with from 6 to 10 men in the gang. In laying steel pipe of large diameter, the use of two derricks is recommended, one at each end of the pipe. Two derricks placed in this manner are much better than one, as the pipe is under control at both ends at all times. The secret of economical pipe laying is to give the pipe gang the trench and let them lay the pipe, and the principal thing for a contractor to give his attention to is the excavating of the trench. In caulking, the lead furnace should be kept as close to the line as is possible. One lead man is sufficient for pipes under 30 inches in diameter, but when this size has been reached, two men should be used.

Backfilling

The contractor has now reached the last step of his job, namely, backfilling the trench and cleaning up. Care should be exercised in this operation to have the trench thoroly tamped so that there will be as little settlement as possible, especially in paved streets. Tamping can be done by hand or machine, but the writer recommends, where possible, the use of water for flushing or tamping. If the ground is not too sandy, water can be used to great advantage. On a contract in Brooklyn, N. Y., on which the writer was interested, water was used for flushing the trench, and at the end of the year's maintenance less than $200 was expended for repairs to the pavement due to settlement. This job was about 2 miles long and the trench was 6 feet wide and 9 feet deep, and 99 per cent was thru paved streets.

In conclusion, the following points must be borne in mind by a contractor on a pipe job: the unloading and hauling of pipe, the excavating of the trench, the laying of the pipe, and the backfilling. When the job is under way, let him push the excavation of the trench, and the rest will almost take care of itself.

Metering Water Carts and Stand-Pipes

A STURDY METER FOR ROUGH SERVICE

In order to know the quantity of water distributed to construction jobs thru the use of water carts or from stand-pipes which are kept continually filled by automatically controlled centrifugal pumps, the Neptune Meter Company, 50 East 42d Street, New York City, has designed a special water cart Trident meter.

These meters are similar in design to the standard Trident Crest type, the housing being slightly modified to meet the requirements of the rugged service for which they are intended. The meters are supplied in two sizes, 1½ and 2 inches, with the water inlet at the bottom and the delivery at one side. The housing of the water cart meter is cast with lugs, which permit of bolting the meter directly to woodwork.

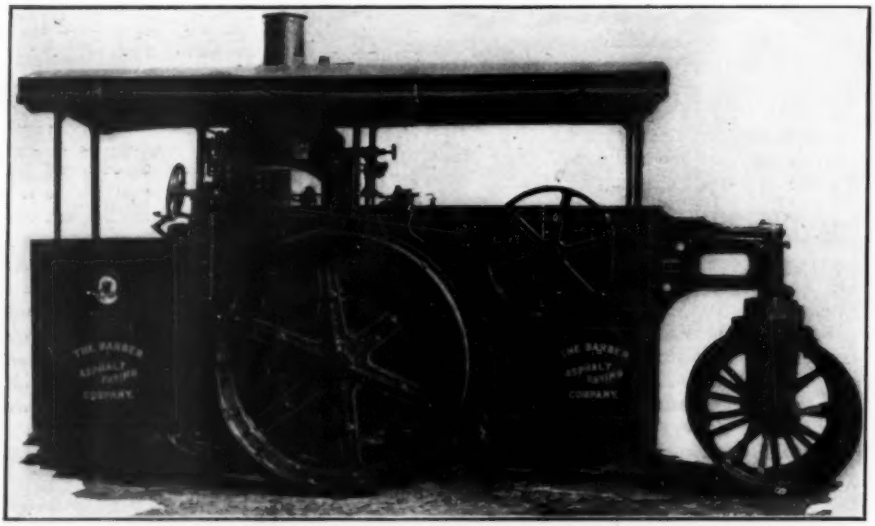
New Macadam Roller Design

Since the invention and perfection of the macadam road roller some thirty or more years ago, there has been practically no change in the design. After many years of experimental work and tests under actual working conditions, the Iroquois Department of The Barber Asphalt Paving Company, Philadelphia, Pa., has perfected and placed on the market an entirely new type of macadam road roller.

The most notable feature of the new Iroquois roller is the vertical boiler which rests upon the steel framework of the roller itself, a separate unit to which nothing is bolted, thus relieving the boiler from any of the racking strains and weights imposed upon the horizontal boiler of the old-type macadam roller. The boiler of the new roller may be easily removed for repairs without disturbing any other part of the roller. It is claimed to have 50 per cent more heating surface than the boiler of the old-type roller. Extreme accessibility and simplicity is the keynote of design, and every part is ruggedly constructed of the best material to perform the work required efficiently and commercially, and is so placed that it is "get-at-able."

The engine is also a separate unit and rests upon the roller framework, on a three-point suspension that has demonstrated its many advantages in automobile construction. The drive is accomplished thru a differential gear to the rear wheels. This may be locked out for hard, straight pulls. Positive steer is assured thru a steel quadrant that prevents the front roll from dragging and shoving up the surface of the highway. The rear wheels are equipped with demountable rims, easily renewed when worn. A steam scarifier is part of the standard equipment. It is adjustable, scarifying to any depth desired the full width of the roller, in the hardest kind of material—a performance which has never been equaled by any other roller.

Shifting of gears is entirely eliminated, and speed changes are made unnecessary, as the engine is much more powerful than in the old-type roller, because of high steam pressure and larger engine cylinders. It has all the flexibility in operation of a tandem roller. Despite the high appearance of the roller, the center of gravity is in reality lower than on the old type, absolutely eliminating any danger of tipping over. It is equipped with a feed water heater to insure economy in operation.



NEW TYPE MACADAM STEAM ROLLER WITH PULLEY FOR BELT TO DRIVE ROCK CRUSHER OR OTHER STATIONARY MACHINERY

Securing Materials for Road Building

Methods for Increasing the Outputs of Existing Plants

By Colonel O. P. Chamberlain

Vice-President and General Manager, Dolese & Shepard Co., Chicago, Ill.

WHEN the writer was requested to prepare a paper for the annual convention of the American Road Builders' Association on increasing the output of existing plants in the production of road-building materials, the labor situation was less troublesome than it appears to be in its present state of development. Were there plenty of laborers who were willing to work, doing a reasonable day's work for a fair day's pay, the problem of increasing the outputs of existing gravel and stone plants, to which the writer will confine himself in this paper, would be comparatively simple.

Labor seems to be war-weary and inefficient. The inflated wage scale and high prices of the war period seem to be augmented since its close, and in resuming our pre-war program we are confronted with conditions new to this generation—unrest, inefficiency and unreasonable wage demands on the part of labor; perhaps undue pressure and impatience on the part of legislatures and other governing bodies in attempting to make up for the three non-productive seasons in highway construction for which the war was responsible.

In confronting our problem as producers of crushed stone and sand and gravel, we realize that our task is both difficult and immediate. It would seem that the first general principle to be adopted is the substitution of machinery for manual labor, wherever possible. Years ago laborers and mechanics inveighed against the use of machinery. The writer distinctly remembers in his young manhood, when working on the farm, hearing the farm hands inveigh against the introduction of harvesting machinery, their grievance being that "machinery was taking bread out of the working men's mouths." The same men or their offspring are probably engaged in watching the wheels of some machine or other go around, with nothing harder to do than to stop the wheels' turning or to report to a superior any irregularities in the working of the machine, and for that service they are receiving a wage undreamed of by their fathers, and living on a scale that to their ancestors would have seemed the height of luxury. To-day the American workingman can, if he desires, participate in practically all wholesome amusements and have all the educational advantages possessed by his employer, living the comfortable, peaceful, honorable life of a citizen of this great Republic.

COLONEL O. P. CHAMBERLAIN

The writer will briefly discuss the various processes of quarry operation, giving what he believes to be the most efficient methods of handling the various classes of work in the preparation of crushed rock. It will be borne in mind that much of this discussion will apply equally well to the handling of sand and gravel pits.

Stripping or Removing the Overburden

The oldest method of removing the overburden was that of ploughing up the topsoil and subsoil, shovelling it onto wagons or carts and hauling it far enough from the theater of operations to make it unnecessary to move the material again. This was followed by the use of slip scrapers and wheelers, and this again by the steam shovel and locomotive crane, small dump cars and a short-line railroad with a "dinky" locomotive removing the strippings from the quarry or gravel pit site to a dump. At times the expense can be materially cut by furnishing filling for some railroad embankment or manufacturing site.

The machine that is most useful, however, most economical and most adaptable for stripping where the overburden runs from 2 to 10 feet in depth is the drag line bucket excavator capable of turning thru an entire circle. It is faster than the steam shovel, and, being built with booms varying from 60 to 100 feet in length, the larger sizes particularly do not have to move very often and can be successfully operated with an engineer, a fireman and four pit men.

In many quarries and pits it is possible to remove the overburden for the new workings and deposit it in the abandoned workings of the quarry or gravel pit in a single operation of the drag line bucket. The ability of the revolving drag line to turn thru the entire circumference of a circle, and in the hands of a skillful operator to dump "on the run," stopping only to dig, makes it the fastest and most economical stripper thus far produced. A product of the present generation, now improved so that it digs as efficiently as a steam shovel, with the advantages above described, the drag line is, in the opinion of the writer, the stripping machine *par excellence*.

When practicable, stripping should be done in the winter and early spring before the busy operating season opens, sufficient for the season's work; the engineer, fireman and pit men can be transferred to a steam shovel when the operating season opens.

Drilling and Blasting

The writer knows of no more economical method of drilling for blasting than the use of the well drill. In the plant operated by him near Chicago, 5-inch holes are drilled for a 40-foot face of Niagara limestone at a labor cost of 10 cents per foot in depth. Here, too, in order to keep the organization together and employ labor to the best advantage, the drilling can be done to a great extent between seasons, following the stripping. When the busy season is at its height, the drillers can be dispensed with and employed in other duties in the quarry. The writer has this winter looked with feelings akin to envy on a neighboring quarry which has sufficient rock stripped for a season's operations, and a large portion of the drilling ready for the dynamite.

In discussing blasting, the writer feels that he is infringing on the prerogative of Tom, Joe or Jerry who is the "powder boss." Was there ever one of these individuals who did not try to impress the superintendent with the idea that there was something mysterious and secret about his process that he would divulge to no one? As a matter of fact, the "powder boss" is frequently wasteful of dynamite, and he is a stiff-necked and almost unteachable individual The writer some ten years ago experimented with sealing the large drill holes above the dynamite charge with a mixture of stucco (quick-setting cement containing plaster of Paris) and screenings, instead of tamping with screenings or sand only. So far as he knows, the process is original with him. Try it on a few holes and see if you cannot cut down your dynamite charge per hole 25 per cent and shake up your rock just as well as you did formerly. It won't cost much to try it, and it may save you some money. Don't try to convert the blasting boss; just stand over him and force him to make the experiment.

Many acrimonious discussions have arisen as to whether it is better practice to drill two or more lines of holes back from the face for a single large blast than to blast out a single line of drill holes for a new face. The writer realizes that he is in a minority in advocating the latter method. Theoretically he fails to see what is gained by setting one blast against the other, which is done when more than a single line of holes are exploded at once, unless the rock is so hard as to require this treatment to break it fine enough to load. In the Niagara limestone, where most of his work has been done, the writer has tried both methods and has convinced himself that making a blast with more than a single row of holes—

which in his particular work, with a 40-foot face and 5-inch diameter holes, he drills 10 feet apart and 10 to 12 feet back from the face—is a waste of dynamite and a squandering of money.

Loading

Loading in small plants and, up to about fifteen years ago, in all crushed rock plants is done by hand. In England and on the continent of Europe hand loading is the accepted method.

In this country the greatest increase in output, the greatest economy in the employment of labor and the greatest decrease in the cost of production can be secured by substituting loading by steam shovel for loading by manual labor, which involves somewhat extensive alterations in plant and equipment. Some idea of the saving in the substitution of the steam shovel for hand labor in loading can be gained from the following data: A steam shovel operating at a cost of $55 per day of 10 hours and producing but 1,000 tons per day, loads at a quarry cost of 7.8 cents per ton against 20 cents per ton for hand loading. These figures include a depreciation and maintenance charge on the shovel of $7,000 per year, and are conservative, as in the writer's own operations the steam shovel performances, averaged over long periods, are 1,780 tons per day of 10 hours. Such operation means a loading cost of but 4.4 cents per ton of stone loaded.

Using the conservative figure of a saving of 7.8 cents per ton in a one-shovel plant, which should produce 400,000 tons per year, the annual saving in the substitution of steam-shovel loading for hand loading is $58,000.

In the installation of a steam shovel plant the size of the shovel should be carefully considered. In general, it is well to let the initial crusher rather than the steam shovel be the limiting capacity of the plant. While you may handle present production with a 60- or 70-ton shovel, you can handle it much more comfortably with a 10-ton shovel, and you are in a position to increase your output materially without a new installation. This installa-

CYCLONE ELECTRIC WELL DRILLER USED TO MAKE HOLES FOR BLASTING IN A QUARRY

tion of a small, light shovel is a common mistake made in converting hand-loading plants into shovel-loading plants. The error is invariably corrected after a few years' steam-shovel operation. It is well, however, to remember that, while a heavy shovel means a large initial cost, this shovel, working considerably below its maximum capacity, is not apt to be delayed by vexatious breakdowns, and its maintenance and depreciation is much less than that of a light shovel that is continuously crowded to its maximum.

Motive Power and Quarry Cars

The substitution of steam-shovel loading for hand loading must generally include the installation of new quarry cars and motive power. Most of the hand-loading plants have men or mules or horses as the motive power for bringing the loaded cars to the foot of an incline, and the cars are hauled up a steep incline to the initial crusher by a steam or electric hoist. In a shovel-loading plant a small locomotive generally replaces the men or mule motive power in the level quarry bottom. It is difficult to load stone with a steam shovel into cars of less than 6 cubic yards (7½ tons) capacity, and a car capable of handling 12 cubic yards (15 tons) is preferable to the smaller size.

In designing your car remember that you are building for the roughest, heaviest duty known. It takes a strongly built car to successfully withstand the impact of 4 tons of rock dropped 3 feet to the car floor. Of course the steam-shovel engineer and cranesman are not supposed to drop the rock 3 or even a single foot, but they sometimes do so with disastrous effect on light equipment. In the writer's own experience he has practically rebuilt the 15-ton cars. They had, originally, axles standard for a 30-ton railroad car. Axles were broken almost daily. Now, with the standard axle for a 50-ton car they are giving good service. The original steel under-frames have been replaced with heavier structural work; the pedestal castings carrying the journal boxes have been redesigned and built of cast steel, instead of gray iron; the car floors, which were originally of 3-inch oak plank, are now of 6-inch oak timbers with an armored carpeting of steel T irons with the stems of the T's let in between the oak floor timbers.

This experience in learning how to build a really serviceable quarry car has been expensive, but it has also been conclusive. The writer congratulates himself that he was not responsible for the original designs of these cars, with the full consciousness that he would undoubtedly have made the same errors that were perpetrated by the designer. Steam-shovel loading was an innovation when these cars were designed. Surely a mechanical engineer should hardly be censured for assuming that a 3-inch-thick oak floor would be adequate for a small car and that a master car builder's standard axle for a 30-ton railroad car would be of more than ample strength for a 15-ton quarry car. He simply failed to appreciate the perversely ingenious, diabolical destructiveness of the careless cranesman.

The Crushing Plant

All that has been said in regard to the changing of a hand-loading plant to a steam-shovel-loading plant assumes a modification of the crushing plant. Most of the hand-loading plants with which the writer has been acquainted contained as an initial crusher a Number 7½, 8, or 9 gyratory crusher. Fifteen years ago, a Number 9 plant was a monster in the Chicago Niagara limestone district. To-day many of the 7½, 8, and 9 crusher plants have been converted into steam-shovel-loading plants by interposing a Number 12 gyratory or some other type of giant crusher between the quarry and the former initial crusher and adding one or more auxiliary recrushing machines in addition to augmenting the screen capacity of the plants to take care of the increased production.

A good Number 9 plant could have been built between 1910 and 1916 at a cost of from $90,000 to $150,000. Such a plant can to-day be converted into a steam-shovel-loading plant by the addition of a Number 12 gyratory crusher and the necessary recrushing and screening accessories, together with a heavy-duty steam shovel and new heavy quarry cars at a cost of from $90,000 to $120,000. While the cost of such plant transformation to-day is at least 100 per cent advance on that of 1916, the practical assurance of adequate demand for one's product warrants the transformation of these small plants even at present high prices for equipment and installation. Re-

member that this country, with its prospective road building, is crying for the increased tonnage.

The modification of existing plants herein discussed means the changing of a 200-ton-per-year plant into a 400-ton-per-year plant. It means doubling the production with less than 50 per cent of the present staff of employes, which in itself in these days of labor scarcity is no inconsiderable item.

A 40-FOOT QUARRY FACE WITH SHATTERED STONE BEING REMOVED BY A 110-TON BUCYRUS STEAM SHOVEL

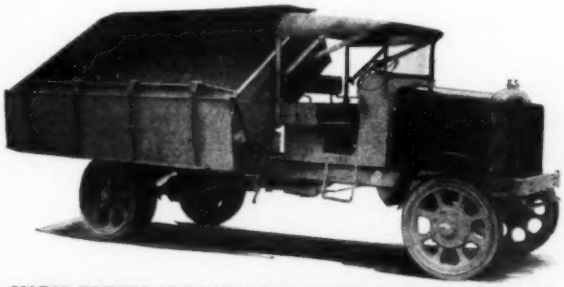
It means, if one cares to put it that way, the return of the entire investment for the rehabilitation of the plant and equipment within the next two years. It means a handsome return to investors, and fine profits to the operators.

It has occurred to the writer that he may be accused of departing somewhat from his text, viz., "How shall we increase the output of existing plants?" His justification is that these hand-loading plants will not for many years be "existing plants" unless the changes herein suggested are made promptly. To paraphrase a recent popular song known as "Mr. Zip Zip Zip, if the steam shovels don't get you, the sheriff must." With the present scarcity of, and high prices for, labor, the hand-loading plant cannot long exist in close competition with the steam-shovel-loading plant. The time is ripe for these small plants to reorganize for higher production and the improvement and rebuilding of American highways.

Other Suggestions for Increasing Output

As has been before stated, much of what has been given in this discussion is applicable to sand and gravel plants as well as to stone-crushing plants. The general principle of substituting machinery for hand labor wherever possible applies to all road materials, cement, asphalt and tar products. Cement is to-day essentially a machine-made product. The elimination of manual labor in the preparation of asphalt and tar products has progressed rapidly during the last decade.

It has been suggested that the production of crushed rock and gravel may be increased in existing plants by working out some definite plan of coöperation between employes and the management of various plants.



MOTOR TRUCKS ARE VALUABLE ASSETS IN THE PRODUCTION AND HAULING OF ROAD MATERIALS. BOTH END- AND SIDE-DUMPING EQUIPMENT WITH HYDRAULIC AND HAND HOISTS ARE FOUND TO BE VERY SATISFACTORY UNDER HARD USAGE. IN REMOVING SMALL STONE FROM QUARRIES AND GRAVEL BANKS SUCH TRUCKS HAVE PROVED ESPECIALLY EFFICIENT

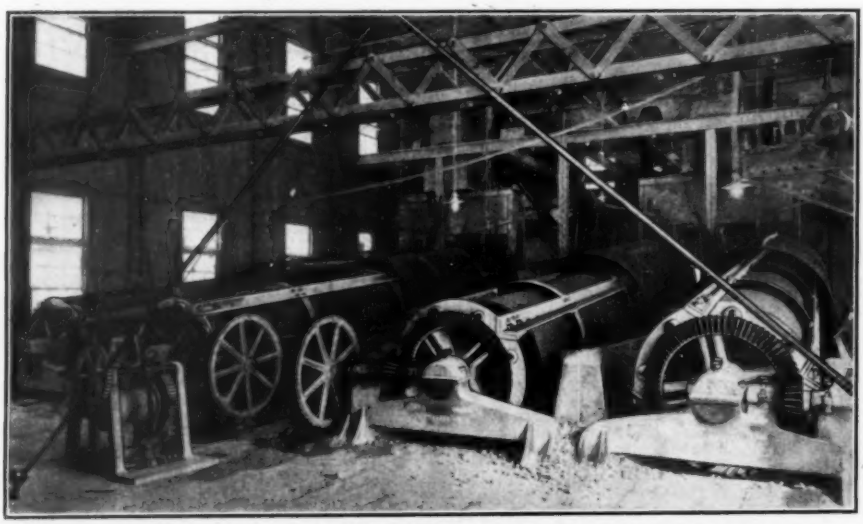
This is hardly a new proposition in manufacturing businesses. Various bonus and so-called profit-sharing systems have been tried from time to time in many industries with varying degrees of success. It has recently been brought to the attention of the writer that one of the gravel companies in the Chicago District has operated for one season under a bonus system quite successfully. A basic cost per ton is set in accordance with past experience. Any saving below this cost is divided pro rata to the fixed wages of the employes among all of them. If there is no saving, there is no bonus, and the management stands any increase above the basic cost. There are serious objections to this system. One is that in a one-steam-shovel plant whether the output is increased and the cost consequently decreased depends on the work of not more than 10 men out of a total of about 40 men who should be employed at such a plant. No matter how diligent and faithful the other 30 men may be, the output of the plant depends on the superintendent, the steam-shovel crew and a few of the attendants at the initial crusher. It seems to the writer that a bonus to these 10 employes only would be more likely to produce satisfactory results than a division among the larger number whose duties are such that their diligence or lack of diligence can in no wise affect the output of the plant.

Again, if a substantial bonus is earned one month and no bonus is earned the succeeding month, labor, in its present mental attitude, will probably demand an addition to its wages equal to the bonus.

Double Shifts

An effective method of increasing the output of existing plants is the working double shifts thru the busy season—the months of July, August, September and October. By timing these two successive shifts so that the first starts work at or shortly before sunrise and the second follows 8½ hours after the first starts, one-half hour being allowed for luncheon for each crew, the working of two 8-hour shifts is perfectly feasible, and has been successfully accomplished.

This necessitates an increase in the normal force of not over 60 per cent, as shop men and repair men may be worked 10 or 11 hours, their shift starting 3 or 4 hours after the early operating shaft and continuing thru the early hours of the second operating shift.



ONE OF THE SCREEN ROOMS OF THE DOLESE & SHEPARD PLANT EQUIPPED WITH WORTHINGTON SCREENS

Open Shop

The writer has always operated under the open-shop system. Some employes are union men, others are not. From a long experience in the handling of both union and unorganized labor the writer is firmly convinced that production would be increased and labor troubles minimized under unions controlled and officered by honest officials. Since the present shortage of labor our troubles have been not with organized labor, but with the "cliques" of so-called unorganized laborers whose demands for more money and still more money are vociferous and continuous. In the writer's experience the labor organizations with which he has dealt have lived up to their agreements, have tended to stabilize the industry, improve working conditions and increase the output. In fairness to organized labor it is a satisfaction to be able to pay this tribute.

The writer has attempted in this paper to briefly suggest some things which may be of benefit to operators in increasing the output of existing plants for the carrying out of the great road program this country has prepared. This article is probably far from being an exhaustive treatise on the subject. If, however, it contains any suggestions of practical value to those engaged in the production of materials for road-building, if its influence even in a small degree increases the output of existing plants and speeds up this great national movement for better highways for America, he will feel that it has been worth while and has not failed in its purpose.

Tractors Solved Hauling Problems in New York's Late Winter Blizzards

During the February blizzards in New York City contractors and trucking companies were greatly hindered by the drifts and snow thrown into the streets when sidewalks were cleaned. In order to help some of the heavy trucks thru the down-town streets the New York Agency of the Cleveland Tractor Company, Cleveland, Ohio, furnished small tractors, as shown in the above illustration, which towed many of the stalled trucks thru the most difficult places.

The Entire Field of Contracting Relies on Motor Trucks

A 1½-TON GMC TRUCK USED BY A CONTRACTOR IN BUILDING A ROAD NEAR ARKANSAS CITY, KANS.

A SERVICE TRUCK WITH COMPARTMENTS USED BY A CHICAGO CONTRACTOR TO BRING MATERIAL TO A CONCRETE PAVER

A KINNEY ROAD OILER EQUIPPED WITH NECESSARY PUMPS AND HEATER FOR ROAD OILING OR RESURFACING WORK

A PHILADELPHIA CONTRACTOR'S GARBAGE AND ASH COLLECTION TRUCK, MANUFACTURED BY THE WHITE COMPANY

Building Twelve Miles of Brick Road in 92 Days

Fourteen Trucks Aid Thomas P. Fitzgerald in Setting New Record for Monolithic Paving on Ashtabula-Conneaut Road

THE main Market Road No. 1 has become the most traveled road in the section of country between Toledo and Buffalo. In fact, it is the chief motor road and carries an immense amount of traffic. The stretch between Ashtabula and Conneaut, however, has been the one weak link, and last fall plans were completed for the paving of this section.

The contract was given to Thomas P. Fitzgerald, paving contractor of Ashtabula, and he began work at once, completing the job September 17, 92 days from the time the first gang started work.

Twelve miles of monolithic brick paving laid in 92 days—a record; and, furthermore, it has been pronounced by state and national highway officials "one of the smoothest and finest monolithic roads in America."

Mr. Fitzgerald inspected the finished road from an aeroplane at a height of 300 feet, making the round trip in 20 minutes. This is the first time a contractor ever inspected his work in this manner.

The November number of the *Ohio Motorist* gave some important data regarding the work:

"A record for speed in permanent road-building, and a world's record in monolithic construction, are claimed in the construction of the Ashtabula-Conneaut road. The construction of the complete monolithic slab was finished in 92 days.

"The work of grading, pouring concrete, and laying brick was started near a midway point in the road, the gang working east. About three weeks later, a second outfit was started; building west. Ninety-two days from the starting of the first gang the entire job was completed. The second gang worked 68 days."

"The average amount of completed road per working day, was 688.7 feet. The average amount of completed road for each mixer was 396 feet. The largest day's run for both mixers, was 1,087 feet; for one mixer 597 feet.

"Labor was transported to and from the job by a special interurban car on the P. & O. Railway. Comfortable housing quarters were furnished for the men, and good board was given in connection.

"No time was lost because of weather or lack of material. Over 1,500 car-loads of materials were used, including brick, sand, gravel, cement, sewer pipe and drain tile. The distribution of material commenced in May, with 4,500,000 paving bricks, followed by graders, sand, gravel and cement distribution. Motor trucks were used extensively in distributing materials on the ground.

"The equipment consisted of a steam shovel, a locomotive, a 10-ton crane, 6-yard dump cars for use on interurban railway, three paving mixers, two power spreaders and tampers for concrete, a fleet of ten motor trucks, dump wagons, plows, scrapers and curb mixers."

The statement "Motor trucks were used extensively" is a very brief way of telling about the work of Fitzgerald's motor trucks. The fact is, the fleet consisted of ten Selden trucks, and one each of four competitive makes.

The average haul was 2½ miles, and the trucks handled an average of 100,000 bricks daily—a total of 6,000,000 bricks—besides the sand, gravel, cement and other materials required.

Have You Road Building Resources Near-by?

Careful prospecting will often reveal unsuspected local resources in construction materials for which a profitable market is waiting, both in the road-building field and in general construction. Commercial development of such resources may have the effect of adding a new industry to the life of a community. Certainly such development will help any community to secure needed paved highways more promptly and at lower cost than might be the case if road-building materials have to be shipped from other locations. Herein, perhaps, lies an opportunity for *you*.

WHAT OTHERS ARE BUYING

The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

Multiplication and Division Made Easy.

Multiplication or division, subtraction or addition—the most involved figuring problems have no terrors for the Monroe Calculating Machine—particularly useful to contractors and engineers in figuring on paving, bridge construction, curbs, sewers and sewer trenches, excavation, grading, trench culverts, or on anything else that involves figuring work. The "Book of Facts," showing how the Monroe will save time for your business, will be sent free by R. M. Farmer, Monroe Calculating Machine Company, Orange, N. J.

Excavators, Backfillers and Tampers.

The bulletin issued by Pawling & Harnischfeger Co., Milwaukee, Wis., serves as a guide in determining the particular type of machine or machines you may need on any excavating or backfilling job. This equipment helps relieve one of the most troublesome and expensive operations that confronts contractors on all kinds of excavation and backfilling work.

Are You Getting the Contractors Atlas?

The Contractors Atlas, a handy monthly publication, issued by the Atlas Portland Cement Co., 30 Broad Street, New York, is being sent, without charge or obligation, to all contractors interested in cement and allied work. In the latest number articles of extreme value were published. If you are doing concrete work, your name should be on the mailing list.

Road Oil—How to Use It.

In a booklet of 24 pages the Asphalt Sales Department of the Texas Company, 17 Battery Place, New York, tells how to obtain best results from road oil. This booklet contains many pictures and six useful tables for road builders. Table number one shows the amount of oil required for one mile of road; table number two shows the amount of stone and sand required for one mile of road; table number three shows the comparative table of temperature; table number four gives the specific gravity and pounds per gallon for various degrees Beaume; table number five, temperature of saturated steam at various gage pressures; table number six shows the asphalt required per mile (penetration method). This booklet will be sent free on request.

"Melting" the Rock Pile.

How to make a good-sized rock pile literally "melt" away in quick time by using the Osgood 6-yard steam shovel is shown in the new general catalog of the Osgood Company, Marion, Ohio.

A Complete Road Plant.

The complete Lakewood road plant, as described in the booklet issued by the Lakewood Engineering Company, Cleveland, Ohio, is a smooth-running machine for the production of maximum mileage of high-grade concrete road in a short working season at a minimum of expense and man power. The plant is composed of independent units as follows: unit one, unloading and storing; unit two, railway haulage equipment; unit three, batch transfer and mixer; unit four, the finisher; unit five, water supply system; unit six, the sub-grader. It is claimed that this plant insures the contractor making a reasonable profit and completing contracts on schedule time.

Rock Drills and Pile Hammers.

Success or failure in contracting work depends largely on the selection of reliable labor-saving equipment. The McKiernan-Terry Drill Company, 19 Park Row, New York City, have a national reputation for turning out quality products. Bulletins describing the rock drills, the Doughboy jack, pile hammers and hammer drills will be sent if you forward your address.

A History of Road Making.

A valuable book is being sent to all road builders who write for it, by the Austin Western Road Machinery Co., Chicago, Ill. This book is devoted entirely to the birth and development of the science of road building, starting from the rude roadways of the Stone Age, then giving brief outlines of the gradual road development made by various ancient nations, thru the Roman period, and so on, down the centuries, to the modern methods of road construction.

A Thoro Mix a Minute.

The concrete-mixing outfit, manufactured by The Jaeger Machine Company, Columbus, Ohio, with automatic power loader, nearly doubles the average daily output of mixer without loader. While one batch is being mixed another is being assembled. One man operates the entire outfit and keeps the gang on the move all the time—10 seconds to hoist loader bucket and load drum; 40 seconds for mixing; 10 seconds for discharging; total, 60 seconds. This means 12 cubic yards per hour—a fair day's work on any job.

Cast Iron Pipe for All Purposes.

In a booklet issued by The U. S. Cast Iron Pipe and Foundry Company, Burlington, N. J., is given a table of approximate weight of embankment materials, per cubic foot, which helps you to determine earth pressures. This company is prepared to make shipments of cast-iron pipe of every size for every use, at the lowest market price.

Sewer-Cleaning Equipment.

The Turbine Sewer Machine Co., Milwaukee, Wis., will gladly send their latest catalog, containing dozens of photographs of actual results obtained by their efficient sewer-cleaning machine.

Data on Centrifugal Pumps.

Dependability, accessibility and the value of centrifugal pumps are described in detail in a booklet which may be secured from the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

A Reference Book on Supplies.

The J. Jacob Shannon Co., of 1744 Market Street, Philadelphia, Pa., is sending, free of charge, to all interested a 325-page book containing detailed information and hundreds of pictures and sketches of all kinds of contractors' and construction supplies and equipment, such as: hoisting engines, concrete mixers, centrifugal pumps, pump engines, locomotives, steam shovels, derricks, etc.

Bigger Day's Yardage From These Pavers.

The Koehring street paving mixers, because of mechanical high-speed operation and automatic actions which make it possible for the operator to maintain top capacity operation every minute of the day, means to contractors lower bids, higher profits and new time records. Illustrated information is being issued by the Koehring Machine Company, Milwaukee, Wis.

Also see next page

Revolving Steam Shovels.
The strongest points and most desirable features of previous revolving-shovel practice have been combined in the Erie Steam Shovel, together with many distinctive, exclusive and patented features. Every detail has been given careful thought, investigation and comparison. The standard has been as high as money and brains would permit. It can be profitably used on road grading, excavation and trench digging. The Ball Engine Co., Erie, Pa., will send further information on request.

Dusty Roads Eliminated.
There is nothing much worse than living in a city or village that makes little or no effort to eliminate the dusty road. The Standard Oil Company of Indiana, Chicago, Ill., has published a 72-page illustrated pamphlet, showing the value and importance of oiled roads and how road oiling aids in preserving the life of city, town and state roads. This booklet will be sent at once if you send your address to F. P. Allen, Manager Road Oil Dept.

Stone Spreaders for Use With Trucks.
Information regarding the use of the stone spreader, which may be attached to any motor truck, for uniform spreading of stone over new roads or for resurfacng, can be procured by writing J. L. Morrow, Secretary, Burch Plow Works, Crestline, Ohio.

Apparatus for Water Purification.
The process of chlorination by application of liquid chlorine is the most efficient means of water and sewage sterilization. Wallace & Tiernan Co., Inc., 349 Broadway, N. Y. C., will be glad to send to all engineers and contractors their new handbook on the science of chlorination. In addition to large units, they also make a portable chlorinator suitable for purifying drinking water for contractors camps.

General Utility Motor Trucks.
The new general utility Autocar, with dumping body, has met with quick response from leading contractors all over the country. Its ability to cover wide territory and stand up under all kinds of loads and its simplicity of operation, make it of extraordinary value in all kinds of construction work. Illustrated descriptive matter may be had from the Autocar Company, Ardmore, Pa.

One Standard of Excellence for a Thousand and One Products.
A list of products, ranging from water meters to pumping engines, from oil engines to centrifugal pumps, from water supply units to tractors, from mining to cement-making machinery and mammoth rock crushers, are manufactured by The Worthington Pump & Machinery Corporation, 115 Broadway, New York City. Descriptive material of any or all of these products can be had on request.

Concrete Construction Handbook.
The Alpha Portland Cement Company, Easton, Pa., is sending free to inquirers a Concrete Construction Handbook containing 96 pages of illustrated and special service sheets on Concrete Inclosure Walls, Garages, Tanks, Driveways, Steps, Barns, Fence Posts, and a dozen other subjects.

Portable Electric Drills.
Little Giant portable electric drills are used whenever quick and efficient drilling is necessary. Progressive contractors will find the printed matter of the Chicago Pneumatic Tool Co., Fischer Building, Chicago, Ill., of extreme value.

Drilling Equipment.
Detailed information, specifications and scores of pictures showing the drilling equipment made by the Sullivan Machinery Co., Chicago, Ill., is contained in a bulletin sent out by this company. Information relative to air compressors, air lift pumps, drill sharpeners, hammer drills and rock drills will also be sent on request.

Preservative Paints.
Millions of dollars are needlessly wasted annually thru rusting, rotting and crumbling. The preservation of structural steel, wood, concrete and other surfaces is a simple matter by protecting them with Toch "R. I. W." damp-resisting paint or compound, manufactured by Toch Brothers, New York City. In their booklet they give a list of hundreds of uses to which their product could be applied.

Heavy Duty Trucks for Contractors.
Heavy-duty trucks, built in 3½- and 5-ton capacity, that are designed for the hardest hauling and will stand up under the severe gruelling received in construction work, are illustrated and described in the latest catalog issued by the General Motors Truck Company, Pontiac, Mich.

Cutting Costs With the Auto Crane.
Bulletin 1020 of the John F. Byers Machine Co., Ravenna, Ohio, presents considerable evidence—first, in photographs recently made showing auto cranes on jobs now building or completed; second, in costs and data and new "short cuts" in road-construction methods; third, in the names of prominent operators who own and use one, two or more auto cranes. Useful hints showing how auto cranes can save you money and greatly help speed up various sorts of construction work are also contained in this bulletin.

Road Forms That Stand Up.
In order to support the new heavy, concrete road machinery now used in highway construction, sturdy road forms are necessary. The advantages of Blaw-Knox forms, manufactured by The Blaw-Knox Company, Farmers Building, Pittsburgh, Pa., are described in the most recent catalog of this company.

Second-Hand Machinery.
Contractors and engineers desirous of securing bargains in second-hand equipment, may obtain interesting lists of such equipment as are on the market, by writing the Searchlight Department of The McGraw-Hill Company, 10th Avenue and 36th Street, New York City.

Long-Lived Shovels and Spades.
Shovels and Spades having especially long life are pictured and priced in a booklet issued by the Pittsburgh Shovel Co., Pittsburgh, Pa.

Drag-Line Cableway Excavators.
Sauerman Brothers, Chicago, Ill., in their catalog No. 7 list all the classes of work for which their drag-line cableway excavators have been installed. The following is a partial list—excavating sand and gravel from under water and from sand pits—loading ballast direct from pits to cars—backfilling—retaining walls—deepening river beds—handling road material—cleaning reservoirs. This equipment will dig, elevate, convey and dump the material in a continuous operation without the use of any intermediate machinery, being controlled by one man. Pictures showing them on actual jobs and dozens of diagrams showing the further advantages of this equipment are also contained in this catalog.

Durable Culverts Make Durable Roads.
The strong, non-rusting, corrugated culverts made by The Newport Culvert Co., Inc., 542 West 10th Street, Newport, Ky., help to extend the life of any road, and once installed will give good service over a long period of years.

Iroquois Macadam Roller.
The new Iroquois Macadam Roller is a very efficient and economically operated roller. Its improvements are based on years of experience in commonsense road building. The Iroquois Sales Department of The Barber Asphalt Paving Company, Philadelphia, Pa., will send literature covering the subject of modern road construction.

Concrete Pavers that Operate Continually.
All the advantages of the continuous operation of concrete mixers, as embodied in the Rex 10-E, are described in the latest bulletins on mixers and pavers, which will be sent you on request by The Chain Belt Company, Milwaukee, Wis.

Meets Every Digging Job.
The "Marion" Steam Shovel, manufactured by the Marion Steam Shovel Company, Marion, Ohio, can be profitably used with great speed and efficiency on road and street grading, basement excavation, sewer and trench work and every other digging job. The many other advantages embodied in the Marion Steam Shovel is explained in their bulletin No. 21, which will be sent on request.

Tractors for Road Building.
Engineers and contractors have found the tractors manufactured by the Advance-Rumely Thresher Co., La Porte, Ind., a valuable auxiliary in road construction work. Illustrated book with descriptions, showing how contractors may speed up their construction work, are available for those sending in their name and address.

The Value of the Associated General Contractors in American Public Works

THE Associated General Contractors of America, a national association of general contractors acting thru representative committees on legislation, labor, methods, contracts, transportation, codes, insurance and bonds, construction development, etc., was organized in Chicago in November, 1918. The association has rapidly forged to the front since its organization, and is now recognized as the predominant contracting association in this country.

The purposes of the association are set forth admirably in its preamble:

"The objects of the association are to promote better relations between private owners and public bodies, their architects or engineers on the one hand, and contractors on the other; to maintain high professional standards in the conduct of work; to combat unfair practices; to encourage efficiency among contractors; to support contractors and contractors' associations in efforts to rectify conditions of an unsatisfactory character; to encourage those methods of contracting for work which relieve the contractor of improper risks; and to encourage sound business methods tending to raise the standing of contractors generally in the business world."

Accomplishments of the Association

The association has already organized nine national committees to represent the interests of general contractors, has established seven association services, three national divisions of general contractors, and sixteen local chapters, including 580 members. Already two national conventions have been held for the consideration of general contractors' problems. The last, held early in 1920, proved to be a tremendous success, has awakened the country to the best benefits of fair, logical dealings with the contracting profession, and has shown the public the right of the contractor in demanding rational specifications and contracts, which do not involve too great a risk for the contracting party. This will react to the benefit of the public, as when the contractor is not asked to assume all of the risk, he is able to offer a more economic bid on the job at hand.

Following is a list of the members of the Associated General Contractors, as of January 1, 1920. Since this list was published about 150 members have been added from various parts of the country.

ALABAMA

Birmingham
- Bostick, P. E.
- Day & Sacks
- Evans Brothers
- Haley, J. O.
- Hetrick, E. F.
- Inglenook Construction Co.
- Jackson Witte Frye Co.
- Lawrenson, Alex.
- Miller Brothers
- Smallman-Brice Construction Co.

Huntsville
- Baxter Brothers

Montgomery
- Blair, Algernon
- Hugger Brothers

ARKANSAS

Little Rock
- Stewart-McGehee Construction Co.

CALIFORNIA

Los Angeles
- Bent Brothers

San Francisco
- Gompertz, Chas. W.

CONNECTICUT

Bridgeport
- Pardy Construction Co.

Hartford
- Grozier Co., J. H.

New Haven
- Sperry Engineering Co.

DISTRICT OF COLUMBIA

Washington
- Arnold Co., R. H.
- Brinizer Co., Warren F.
- Cranford Paving Co.
- Gormley Co., P. F.
- Hampton, Thomas
- Harris, Samuel R.
- Porch, Wesley B.
- Standard Engineering Co.
- Wagner, Frank L.
- Whitty, R. P.

FLORIDA

Pensacola
- Proudfoot Co., G. F.

GEORGIA

Atlanta
- Carr & Co., H. J.
- Flagler Co., The
- George, Wm. H.
- Griffin Constr. Co.
- Krebs Co., A. J.
- McCreary Co., J. B.
- Southern Ferro Concrete Co.
- Walker & Co., R. M.
- Warner, S. J.

Augusta
- Palmer Spivy Constr. Co.

Columbus
- Hardaway Contracting Co.

Macon
- Beeland, W. J.

ILLINOIS

Alton
- Wuellner & Son, J. J.

Chicago
- Bates & Rogers Const. Co.
- Brundage, Avery
- Chicago Foundation Co.
- Dreher Construction Co.
- Forschner Company, T. J.
- Great Lakes Dredge & Dock Co.
- Griffiths & Son Co., John
- Heyworth, James O.

Jones Co., Fred R.
Kelly Atkinson Const. Co.
Krahl Construction Co.
Lanquist & Illsley Co.
Leyden-Ortseifen Company
Mellon-Stuart-Nelson Co.
Mueller Construction Co.
Nash-Dowdle Co.
Roberts Brothers & Peterson
Snyder Co., J. W.
Sproul Co., E. W.
Strobel Steel Construction Co.
Wells Bros. Construction Co.
Witherspoon-Englar Co.
Yale & Reagan

Danville
Moore, E. S.
Yeager & Sons

Moline
Lorenz, P. H.

Peoria
Jobst & Son, V.

Rockford
Beckstrom Co., Ross P.

Rock Island
Horst Co., Henry W.

Springfield
Fitzsimmons, Frank

St. Elmo
Johnston, P. M.

INDIANA

Carbon
Quigley & Bonner Co.

Evansville
Bippus & Son, Jacob

Scottsburg
Mitchell, H. G.

South Bend
Christman Co., The

IOWA

Cedar Rapids
Stark & Co., Theodore
Wilhelm Co., Inc., Geo. T.

Davenport
Walsh Construction Co.
Woolsey Construct. Co., M. W.

Des Moines
Koss Construction Co.
Weitz Sons, Chas.

Keokuk
Cameron, Joyce & Co.

Mason City
Moen Co., M. M.

KANSAS

Leavenworth
Missouri Valley Bridge & Iron Co.

Topeka
The Topeka Bridge & Constr. Co.

KENTUCKY

Louisville
Bickel Co., Henry
Bott, John
Brashear, W.
Bredemann Brothers
Eady & Co., G. M.
General Const. Co.
Greiner & Son, Tobe
Hancock, L. W.
Keller & Sons, Louis
Koerner & Co., C. A.
Lichtefeld, Metzner & Co.
Marsham & Co., A.
Miller Co., Wm. B.
National Concrete Const. Co.
Platoff & Bush
Rommel Brothers
Rommel Co., Geo. H.
Struck Co., Alfred
Vaughn & Son, Sanford
Wirth & Son, Philip

Newport
McLane Co., J. B.

LOUISIANA

New Orleans
Babins Sons, A. C.
Bond & Bro., W. H.
Burns, Henry P.
Caldwell Bros.
Chisolm, J. O.
Craven & Lang
Dalgarn, L. M.
DeFraites, J. M.
Drennan, Albert
Favret, Lionel F.
Fromherz, Jos.
Garrett, A.
Geary Oakes Co., Inc.
Geary, Wm. M.
Glover, Geo. J.
Gwin Constr. Co., O. M.
Haase, Jr., J. A.
Hanna & Mitchell
Hinrichs, H. F.
Jefferson Construction Co.
Lambou, Victor
Larsen, Chris.
McCarthy, Jr., R.
Markel, Edward
Markel, R. W.
Moore, E. N.
Neilson, Chris.
O'Keefe, Hugh A.
Reimann, G. E. & E. E.
Reiss, John
Rodick, J. A.
Sharp, Otis
Toelke, J. M.
Toups, J. A.

MARYLAND

Baltimore
Collins, Jr., R. G.
Consolidated Engineering Co.
Fideli Co., The A. F.
Miller, Inc., J. Henry

Cumberland
Vang Construction Co.

Hagerstown
Angle, W. H.

MASSACHUSETTS

Boston
Aberthaw Construction Co.
Converse & Co., H. P.
Edwards & Monahan
Nawn Construction Co., Hugh
Stone & Webster
Warren Bros. Company
Woodbury & Sons Co., I. F.

East Boston
Bay State Dredging & Constr. Co.

Holyoke
Casper Ranger Construction Co.

Northampton
O'Connor, M. I.

Palmer
Flynt Building & Construction Co.

Springfield
Ley & Co., Inc., Fred T.

Worcester
Bishop Company, J. W.

MICHIGAN

Battle Creek
Snyder & Son, H. V.

Detroit
Albrecht Co., A. A.
Baker Co., R. D.
Bryant & Detwiler Co.
Christman Co., H. G.
Cooke, George R.
Cooper-Widenmann Con. Co.
Culbertson & Kelly
Davis, Frank H.
Dunbar & Sullivan Dredging Co.
Jackson Construction Co., E. D.
Ladue, John T.
Mercier, J. A.
Otis Cement Construction Co.
Sisman Co., Andrew C.
Smith Construction Co., A. J.
Walbridge-Aldinger Co.
Wood Co., W. E.

Kalamazoo
Byers Bros. Construction Co.
Van der Horst, Henry L.

Pontiac
Scharl, G. P.

St. Joseph.
Lyons, Ira J.

MINNESOTA

Aitkin
Foley, Inc., D. A.

Minneapolis
Kelly & Co., H.

Winston Bros. Company
Winston-Dear Company
St. Paul
Foley Bros.
Guthrie & Co., Inc., A.
Siems, Helmers & Schaffner

MISSOURI

Kansas City
Fogel Construction Co.
Smith Construction Co., L. J.
St. Joseph
Hotchkiss, Sam
St. Louis
Carmichael-Cryder Co.
Fruin-Colnon Contracting Co.
Heman Constr. Co.
Moreno Construction Co.
Murch Brothers Construction Co.
Scott, John R.
Selden-Breck Construction Co.
Steininger Construct. Co., E. A.
Sutherland Bldg. & Con. Co., W. M.
Tait & Nordmeyer Eng. Co.
Unit Construction Co.
Westlake Construction Co.
Wimmer Contracting Co.
Woermann Construction Co.

NEBRASKA

Omaha
Omaha Struct. Steel Bridge Co.

NEW JERSEY

Garfield
Harrop, J. T.
Hoboken
Dock Contractor Co.
Newark
Becker Construction Co.
Essex Construction Co.
Fusco, James J.
Waldron, Inc., Edw. M.
Paterson
Ferguson Co., John W.
Westfield
Weldon Contracting Co.

NEW YORK

Amsterdam
American Pipe & Const. Co.
Turner & Sons, John J.
Brooklyn
Borough Asphalt Co.
Brooklyn Alatraz Asphalt Co.
Cranford Co.
Cranford, Inc., Frederick L.
Eastern Contracting Co.
Gahagan, Inc., W. H.
Guinan Contract. Co., John J.
Newman & Carey Subway Construction Co., Inc.
Buffalo
Berricks & Sons Co., Chas.
Buffalo Dredging Co.
Cowper Co., John W.
Eastern Concrete Steel Co.
Horton Construction Co., D. E.
Huntley & Derdenger Corp.
Lathrop, Shea & Henwood Co
Lupfer & Remick
Monarch Engineering Co.
Mosier & Summers, Inc.
Tifft Construction Co., Inc.
New York City
Ambursen Construction Co.
Beaver Eng. & Contract. Co.
Booth & Flinn, Ltd.
Bouker Contracting Co.
Brusstar, James L.
Carey, W. F.
Cooper, Inc., William G.
Cox Contract. Co., Inc., P. T.
Crimmins Cont'ct. Co., Thomas
Cullen Transportation Co., Inc.
Daniels Company, Oscar
Degnon Contracting Co.
Diebitsch, Emil
Empire Engineering Co., Inc.
Fissell & Co., W. H.
Fitzgerald, W. J.
Ford, Bacon & Davis Corp.
Foundation Company
Fraser, Brace & Co.
Fuller Co., Geo. A.
Gillespie Co., T. A.
Godwin Construction Co.
Guarantee Construction Co.
Hastings Pavement Co.
Hoggson Bros.
Holbrook, Cabot & Rollins Corp.
Jarrett Chambers Co., Inc.
Jobson-Gifford Company
Kaufman & Garcey
Litchfield Construction Co.
Lord Construction Co.
Mason & Hanger Con. Co.
McGovern & Co., P.
McHarg-Barton Co.
MacArthur Brothers Co.
Melrose Construction Co.
Merritt & Chapman Derrick & Wrecking Co.
Miller, Daybill & Co.
Monks, John, & Sons
North-Eastern Construction Co.
O'Rourke Eng. Const. Co.
Rapid Transit Subway Construction Co.
Raymond Concrete Pile Co.
Rogers & Co., Inc., George W.
Rodgers & Hagerty, Inc.
Sicilian Asphalt Paving Co.
Smith, Hauser & MacIsaac
Smith, F. V., Inc.
Snare & Triest Co.
Spooner & Son, Inc., Allen N.
Steers, Inc., Henry
Terry & Tench Co., Inc.
Thompson-Starrett Co.
Underpinning & Foundation Co.
United States Realty & Improvement Co.
U. S. Structural Co., Inc.
Uvalde Asphalt Paving Co.
Westinghouse Church Kerr & Co., Inc.
Wilson & English Con. Co.
Winston & Co.
Niagara Falls
McKinney Corporation, John F.
Rochester
Curran-Swartout Co.
Rome
Scott Brothers
Syracuse
Burns Co., W. J.
Taylor Construction Corp.
Utica
Troy Public Works Co.
Woodhaven, L. I.
Ferry & Sons, Inc., James

NORTH CAROLINA

Durham
Rigsbee, C. D.

OHIO

Cincinnati
Byrnes, J. A.
Cannell, C. E.
Cash, R. E.
Cavanaugh, A. J.
Connelly Co., M. J.
Crumley, Jones & Crumley Co.
Evans, Thomas
Ferro Concrete Const. Co.
Foley, D. P.
Gradison Constr. Co.
Henkel & Sullivan
Kirschner Constr. Co.
Maloney, Thomas
Quill, M. F.
Ruebel Constr. Co., John
Runck Bros. Constr. Co.
Runck, Jr., Charles F.
Scully Bros.
Strack, Thomas P.
Wagner & Boehning
Welling & Franz
Cleveland
Austin Company, The
Bolton-Pratt Construction Co.
Central Dredging Co.
Cleveland Eng. Const. Co.
Craig Curtiss Co.
Crowell-Lundoff-Little-Bicknell Co.
Drummond Miller Co., The
Emerson Co., Samuel W.
Feaga Co., The

Gill & Sons, John
Gloyd Co., James R.
Hunkin-Conkey Const. Co.
Lane Construction Co., A. A.
Masters & Mullen Const. Co.
Minnick-Gibbons Co., The
Newhall Co., Walter S.
Reaugh & Son
Strong & Son, Chas. H.

Columbus
McGrath & Sons, D. W.

Dayton
Blagg Co., The H. R.
Danis Hunt Construction Co.

Lorain
Donnelly Co., W. J.

Norwood
Murdock, Geo.

Toledo
Bentley & Sons Co., A.
Carland & Co., John C.
Comte, J.
Spicker Co., Henry J.

OKLAHOMA

El Reno
Witcher, E. L.

Enid
Burbank, C. J.
Hyde, Carl H.

Oklahoma City
Farmer, R. D.
Humphrey, W. G.
Landon, C. G.
Maney, J. W.
Swatek, M. A.
Western Paving Co.

Tulsa
Comstock & Smedley

Wayne
Terry, E. C.

OREGON

Portland
Warren Construction Co.

PENNSYLVANIA

Bethlehem
Garber, Earl A.

Easton
Smith-McCormick Co.

Erie
Shenk Co., Henry

Philadelphia
Irwin & Leighton Co.
Keystone State Construct. Co.
Smith Contracting Co., E. E.
Warren, Moore & Co.
Wiggins Co., Inc., John R.

Pittsburgh
Blaw-Knox Co.
Dravo Contracting Co.
Ferguson, Edmondson Contracting Co.
Mellon-Stuart Co.

TENNESSEE

Chattanooga
Brandon, D. F.
Becking & Son, Geo.
Bender, Baxter
Chambers & Son, Luther
Chickamauga Quarry & Constr. Co.
Hahn, A. F.
McDevitt Fleming Co.
Moudy & Co., T. S.
Parks & Co.
Smallwood Contracting Co., L. C.
Wilson Co., Mark K.

Memphis
Alexander Constr. Co., James
Barker, J. C.
Canal Const. Co.
Cooke, B. W.
Crawford Co., D. M.
Hodges, Elmer G.
Kent Co., H. R.
Larimer & Burgett Bridge Co.
Malkin, S.
Ozanne & McKnight
Pearson, E. J.
Reeves & Son, J. M.
Thomas & Son, D. D.
Wagner, D. C.
Young & Son, Fred B.

Nashville
Foster & Creighton
Gould Contracting Co.
Holladay, E. C.
Howard & Sumner Constr. Co.
Jacobs, H. P.
Rock City Constr. Co.

TEXAS

Dallas
Davis, B. F. & C. M.
Watson Company

El Paso
Ware, V. E.

Galveston
Larkin & Sangster

Houston
American Construction Co.

San Antonio
McKenzie Construction Co.

UTAH

Salt Lake City
Lynch-Cannon Engineering Co.

VERMONT

Burlington
Cashman, James E.

VIRGINIA

Charlottesville
Rinehart & Dennis Co.

Petersburg
Harrison Constr. Co.

Richmond
Wise Granite Construction Co.

WASHINGTON, D. C.
See District of Columbia

WASHINGTON

Spokane
General Construction Co.
Porter Bros. Co.

WEST VIRGINIA

Wheeling
Kitchen & Co., R. R.

WISCONSIN

Janesville
Cullen, J. P.
Ford, Boos & Schoof

Milwaukee
Coddington Eng. Co.
Dahlman Constr. Co.
Foster Construction Co.
Kroening Constr. Co.
Michie Constr. Co.
Newton Co.
Northern Constr. Co.
Raulf Co., The
Reisinger Co., R. L.
Riesen Bros. Company
Reisen Sons, Paul
Schmitt & Son, Inc., H.
Siesel, S. M.
Steinhagen & Klinger
Steigerwald Co., Ed. S.
Tubesing Co., Wm. F.
Wisconsin Constr. Co.

QUEBEC

Levis
Lauzon Engineering Co., Ltd.

Pick and Shovel, or Machine—Which?

By Zenas W. Carter

Secretary and Manager, Material Handling Machinery Manufacturers' Association, New York City

THE big problem of the day is "Pick and shovel, or machine—which?" "Pick and shovel" costs more than twice as much as ever before. Will a machine cost less? Such is the problem confronting every man in the world who must produce in quantity with speed and economy.

In the captions under the accompanying illustrations are brief statements of savings made thru the use of machines to supplant manual labor. In most construction work in the United States the day of the man and the pick and shovel is past. The transition from "the gang" to "the machine" has been very rapid indeed, and yet it came so naturally that the majority of the public at large have not yet realized that the day of the pick and shovel is gone.

It is gone because the world-demand for quantity production and speed is so great that the human being cannot meet it thru his own physical effort. Human hands must have time for their productive and creative efforts. To-day's demands for the time of human hands are greater than the supply. Seldom do we see a gang of Italian laborers at work on an excavation for a building; we hear a chug and a thud, and note that a gigantic engine and a digging shovel are dropping cubic yards of dirt into a dump-wagon almost as fast as the eye can follow the motion.

The railroad gang on the section work are tamping ballast into place with a pneumatic tamp instead of a pick. The road-makers are building roads by the mile instead of by the running yard, and the men required to operate the road-building machinery—spreaders, mixers, conveyors, industrial narrow-gage railways alongside, the trenchers, the tractor trucks and trailers,

INGERSOLL-RAND TIE TAMPERS ON THE PENNSYLVANIA RAILROAD BETWEEN PAOLI AND PHILADELPHIA

With automatic tools, two men do the work of ten picks and hand tamps and do it better, with no drudgery

A LIDGERWOOD EXCAVATOR USED AS A DERRICK TO RAISE A WELL-DRILLING OUTFIT FROM A QUARRY IN THE MIAMI CONSERVANCY DISTRICT

the motor trucks, and the huge plows—all counted, are fewer in number per mile than were formerly needed to build a quarter of the distance. What is still more important—the men who are at work are relieved of much of the difficult and back-breaking drudgery of digging all day with pick and shovel or trundling a barrow.

In our dredging work we take up the soil from below as we move forward with the ditch or canal, or deepening of the channel, and with a toss, like the shaking of a bull's head, place the lifted soil alongside—all "by the simple twist of the wrist." In building bridges, dams, ships, steel structures, and similar great engineering projects, it is machines, and more machines, which enable us to fabricate a majority of the structure at the mill and to place it easily, quickly and economically when it reaches the required destination.

In our great manufacturing plants also there has been much progress in the use of cranes, conveyors, telepher systems, industrial trucks, trailers, modern elevators, chutes, and other auto-mechanical machinery. Especially has their use been extensive in working out progressive production in automobile factories.

What America must do immediately, if her makers want to enter world competition in earnest and stay in world trade after Europe gains her stride, is to change to machine-handling operation in preference to man-handling operation wherever possible, and to continuity of process in manufacturing, building, mining, "transferation" and transportation. It is indeed unfortunate that so few men in industry and in contracting and engineering are familiar with the various types of mechanical handling machinery and the variety of their application to endless numbers of operations. This is largely because most of the work has been special construction, where progressive production plants have been developed, and the manufacturers of material-handling machinery have generally been so busy that they have felt it unnecessary to advertise widely. Another important cause has been the plentiful supply of common labor which was available before the war started in Europe, coupled with the fact that the great stride forward in the handling-machinery industry was the result of the war demands for quantity production at minimum costs.

During the war much recently invented machinery was extensively used because of the necessity for speed and extraordinary accomplishment in construction and engineering problems. Yet even during that period of stress and man shortage the high wages and the war demand were the cause of great waste of man-power which machinery would have saved. Most of this waste was due to lack of knowledge of equipment and machines—the result of having inexperienced men in management. On the war

front industrial narrow-gage railways and "mine" cars, united with cranes, tractors, motor trucks and portable conveyors, made success possible.

An illustration of machine-handling creation following necessity was exhibited last summer at Des Moines, Iowa. When the Fred Weitz Construction Company started the new Des Moines Hotel, it was soon discovered that common labor was not available at any price. The company was under penalty for delivery. Some method of speeding delivery of concrete must be found.

In Fred Weitz work-necessity had developed creative ingenuity to the *n*th power. He called in a conveyor manufacturer and presented his problem, and within three weeks they originated a complete progressive production system for mixing concrete which eliminated all hand shoveling and barrowing of sand, gravel and cement. All was conveyed automatically from storage to mixing machine, measured and fed into the mixer, and, after mixing, the concrete was discharged directly to the point of need. The equipment, designed and erected in this short time, had solved both a labor and a cost problem.

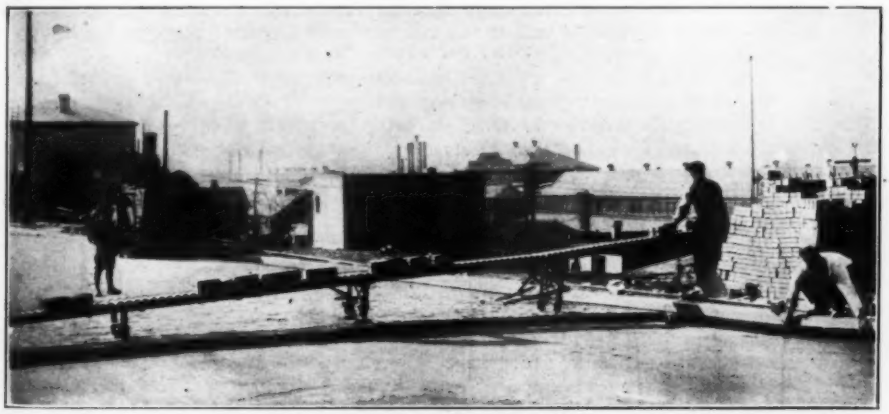
At the Birdsboro Stone Company plant in Birdsboro, Pa., an installation of continuous bucket conveyors is handling 400 tons of trap rock per hour. In this case, 42-inch buckets are attached to two strands of 30-inch pitch chain, carried by large-flanged rollers every second pitch. This equipment is reported to have handled 500,000 cubic yards of rock without expense for repairs. The buckets take the rock from the chute at the bottom of the hopper located immediately under the stone crusher. They travel at a speed of 60 feet per minute, and their span is 105-foot centers.

For that matter, there are hundreds of belt-and-bucket conveyors in the United States delivering bulk products to storage or reclaiming and delivering into barges or cars, while other thousands of similar operations are expensively man-handled at an enormous waste.

Too few engineers and contractors use the banker's method of figuring investment for equipment and machines, for it is undoubtedly true that machine first cost may be economically based as a wise expenditure if the original expense is not over $2,000 to $2,500 per man saved.

On large-area construction work and where travel is irregular or rail is not available, the tractor, or the caterpillar locomotive crane with a long boom, is almost invaluable. It will carry heavy loads, lift and place large, irregular, or heavy structural members or other machine equipment, and may be set to work anywhere for continuous, almost automatic, duty, serving any quantity of material that is being used.

Crane operation and care should always be in the hands of competent men. With proper handling, oiling and general lubrication, the crane has a life of from 15 to 30 years. Ingenious men also work out many



A GRAVITY CONVEYOR HANDLING BRICK ON A HIGHWAY JOB, SAVING THE LABOR OF ONE MAN PER DAY

new and novel uses for cranes. At the Richmond Brick Company plant on Staten Island all brick are piled into standard units on wooden trays as they come from the kiln, and they are then very economically and easily handled by a 2-ton-capacity crane.

Gravity conveyors used with wooden pallets are simple, inexpensive and portable, and save man-power at a rate almost unbelievable. Still the average construction job goes along, almost the country over, without a single thought being given to this valuable "lift and carry" eliminator.

Portable winches and hoists are so generally in use that it seems superfluous to urge their use on construction work. It is necessary, nevertheless, to urge their use in multiples as time-savers on speed work. On the Kensico Dam construction over 40 hoists were constantly in service.

In municipal and power plant coal-handling there is revolution in method now under way on account of labor costs. Coal-handling equipment of the conveyor or overhead trolley and mono-rail type is being rapidly installed everywhere. These systems permit direct unloading without manual handling: first, from car to storage pile; then from storage to stoking door or automatic stocking bins. Pulverizing machines are also making headway in these fields, and recent development in handling pulverized coal will soon make it economical and practical to feed this coal thru pipe line direct to fire box, with automatic thermostatic control of the fuel feed—the entire handling operation as simple as oil handling, while pulverized coal costs much less.

In the freight-handling field the change from "the man with the truck" to "the machine" is to be the epoch feature of this generation for l. c. l. movement. An installation has been recently completed at Cincinnati, Ohio, by which the exchange of all l. c. l. interline freight between the 28 different main and sub-freight stations of the 7 different railroad lines entering the city is being made thru the use of uniform containers or demountable bodies, motor (chassis) trucks, and overhead electrical traveling cranes and electric hoists operating on overhead rails. This is not only epochal as a reformation in freight-handling methods, but is proving so tremendously economical to the railroads and is expediting freight movement so much for the shipper that the value of the system is self-demonstrating. No student who witnesses the operation of these trucks and the handling of the freight into and out of these containers would leave with doubts in his mind. There economy, efficiency, simplicity, speed and safety of transit are grouped for a progressive movement of freight at a

A MARION STEAM SHOVEL IN THE MIAMI CONSERVANCY DISTRICT LOADING DIRT INTO DUMP CARS FOR FILL

minimum of investment for the railroad.

In freight or cargo handling at terminal points at seaboard the United States is far behind Europe, and especially behind England and Germany, in the use of mechanical methods instead of hand methods. At Manchester, Liverpool, London, Hamburg, and other large, and even the smaller, ports of Europe, there are numerous gantry and semi-portal cranes, locomotive cranes, derricks, etc., for use in handling miscellaneous cargo, as well as winches, telepher systems, conveying systems, and industrial trucks and tractors. And wages are and have been less than in the United States, and their labor less educated and more willing to do arduous tasks.

Automatic elevators, or conveyor unloaders, also tend to greatly reduce the burden of manual labor required for handling large quantities of the lighter and more uniform shipments, such as bags, boxes, barrels, and bundles weighing less than 400 pounds. In the United States, however, there is very little automatic machinery used at any East Coast port, other than New Orleans, Galveston, and Beaumont, Tex., for the handling of miscellaneous cargo. At Beaumont, Galveston, and some of the Pacific ports, the semi-portal gantry cranes are in use, and New York City has agreed to install about thirty of these gantry cranes on two of the twelve new piers (the two for the Pan-American Terminal and Dock Company) to be erected on Staten Island. Even this they consider a concession in New York, and it is an astonishing fact that practically none of the present piers and only two of the contemplated piers will have any provision for mechanical instead of manual methods of handling cargo, for installation either now or at a later period.

Worse still, all the old pier structures are too light and too small in area to permit mechanical or progressive handling, and all the new structures planned are duplicates of the old types, with the exception that they are slightly wider and very much longer. This excessive length (1,100 feet) for the very narrow width (125 feet) is of itself proof that it will be impossible to handle cargo in these pier sheds without congestion and vexatious delays whenever there are four ships alongside taking and discharging cargo at the same time.

Some of the present Staten Island piers have been paraded as modern, but a visit will reveal the fact that they are merely "elongated barns" of a substantial structural character, but all one-story sheds with no rail connections to boat-side, as in all of Europe, and with no provision whatever for any mechanical unit, not even a hoist. The only things on the latest of these piers that are different from what existed in the days of the Phoenicians are the two-wheel trucks and the few four-wheel small one-horse-drawn trucks, and I have several times seen men pushing to help the horse out when a heavy load was on the small truck.

All the foregoing has been said to emphasize the need for prevision in purchasing, in designing, and in construction.

Wherever four or five men are performing the same kind of handling day after day it is very probable that a study of the complete market in handling-machinery, or the use of a little vision, will reveal some means of using the machine to eliminate the pick and shovel. Every day is bringing forward some new application of some handling unit now in service on some other problem. The Cincinnati method of truck and container (or demountable auto body) if put into use in New York City for store door delivery would instantly eliminate all the dreary and expensive hours of waiting on West Street which hundreds of men, horses and automobiles now suffer every working day in the year. The use of cranes and conveyors, tier-lift and tractor trucks and trailers, and tiering machines for handling all of the cargo going into and out of New York would relieve the longshoremen of the endless hard physical labor they now perform, save them their swollen hands, their days off to rest, and actually start these men upward in life by the very opportunities they would find to improve themselves in their spare time, if they were not carrying physically the daily burden which the machine should perform.

Gravity conveyors, locomotive cranes, cable ways, and even industrial trucks and containers, could be used to greater advantage in quarrying stone, around brick yards, cement block manufacturing plants, etc. Derricks, winches, hoists, telepher systems, costing only a small outlay, will frequently pay for themselves in savings made, even if used only a few days each month for building construction work. It

is surprising at times, when a careful pencil and paper survey is made, to learn that a job which takes only a half-dozen men a few days every other week may be handled by one man in less time if he is given a machine to do the work, and the actual saving in labor cost—especially at to-day's high rates—will more than pay for the machine the first year and the machine's life without repair need, or with only minor repairs, will easily run ten, and sometimes twenty or thirty years. Some cranes are still in service after forty years, and have paid for themselves almost forty times over.

The United States Navy Yards at Brooklyn and Washington, D. C., and the Newport News Shipbuilding Company have recently installed a new system or process for reproducing original tracings on tracing cloth which adds "a machine" to drafting-room production that accurately does the work of numbers of "pen and rule" men, thus speeding up plan design tremendously. With this machine they reproduce parts of tracings and make changes with a minimum amount of manual "pen and rule" work, thus releasing capable draftsmen for more important work.

Pencil and paper, and diagram showing all costs; a careful search in the market and among manufacturers; a half-day in research;—thousands of times this has revealed a way to turn the work out by machine rather than by pick and shovel, and still make money and have the machine for extra profit.

Distributing the Surplus Army Motor Trucks

A further evidence of the coöperation of the Federal Government with state commissions for better county and state roads is seen in the immense movement of motor trucks into the various states where this work is in progress or is about to be started. This incessant stream of trucks, which are being shipped out continuously from various cities where they have been held in "cold storage," constitutes the surplus stock ordered by the Government during the war.

Of the 15,000 military trucks turned over to the Government by the Four-Wheel Drive Auto Company, Clintonville, Wis., makers of the FWD, there now remain more than 2,000 machines, as a surplus. These are being shipped out at the rate of 100 per day, from storing centers in Chicago, Indianapolis, and Fortress Monroe, Va. The effect this fleet of trucks, including others of virtually every well-known make, will have in the better roads movement, is easily apparent when it is considered that the total number declared surplus amounts to approximately 25,000.

THIS FWD TRUCK DIDN'T HAVE A CHANCE TO GO OVER THE TOP, BUT IT WILL DO AN EQUIVALENT JOB IN BUILDING STATE ROADS THIS SEASON

According to the figures of distribution, at least 2 of these machines, and as many as 58 in one instance, will be sent to every state in the country. This truck proved its worth during the war, and, in its arrangement of distribution, the Government is placing the trucks where they can be used with the greatest possible efficiency.

Using the Tractor to Clean City Streets

Tractor Hauls Snow-Plow After Eleven-Inch Snowfall in Grand Forks

By G. S. Giles
City Engineer, Grand Forks, N. D.

THE past winter has proved so trying to many municipalities in the matter of keeping streets open that many unusual devices have been put into operation thruout the country for this purpose. While in Grand Forks it is not necessary to completely remove the snow from the streets, as is the case in more congested communities, it is very necessary that drifts be removed and that the streets be made reasonably clear for traffic.

On November 10 the first heavy fall of snow came to Grand Forks. It amounted to 11 inches falling in 24 hours, accompanied by a high wind, which drifted the snow from 2 to 3 feet deep on some of the streets. In order to attack these huge drifts, a snow-plow was built of 2-inch planks, 2 feet high and with a spread of 15 feet, with extended parallel sides of 8 feet in order to keep it from sluing. On November 18 a demonstration was held in the city, when this new heavy snow-plow was hauled by a Holt tractor to open up the street.

Between November 10 and 18 there was a thaw and the snow was wet and hard to handle, but the tractor successfully hauled the plow and opened the streets in a very satisfactory manner. The City Council expressed its willingness to purchase the tractor to be held in readiness for this type of work and other municipal hauling during the summer, but there was no appropriation in the street fund to cover the expenditures, so it was impossible to purchase it at that time. From the demonstration the municipal officials were well satisfied that this method of opening up streets is satisfactory, economical and thoro, particularly if it is possible to get on the streets during the storm or immediately after it, before traffic is moving and packing the snow.

A CATERPILLAR TRACTOR HAULING A HEAVY SNOW-PLOW IN GRAND FORKS, N. D., BREAKING OPEN THE ROADS AFTER HEAVY SNOWFALL

What Type of Discharge for Concrete Mixers on Road Jobs?

In some districts, paving contracts call for a paving mixer equipped with the particular type of discharge favored in the eyes of the engineers in charge. This has in many cases brought some hardship to bear on the contractor, because he could not use the equipment on hand, from which he had probably not gotten the full value of his investment. Not infrequently it has been necessary for him to either sell (generally for little more than " a song"), or allow his paver to stand idle, and purchase a new machine which fulfilled the demands of the specifications.

It is not the intention of the engineers in charge to be arbitary, or to design rules which will work hardship and limit the profits of the contractors. Far from that, it is their zealous desire to insure good, lasting roads for their constituents which prompts these demands. True, some of the requirements inserted in many specifications with reference to the delivery of the concrete are entirely irrelevant and have no bearing on the ultimate results obtained. Yet their presence can hardly be laid to ill motives, but rather to misapplied knowledge of the conditions.

For example: Recently some specifications have been issued demanding the boom-and-bucket delivery as against the chute system. By so doing, the engineers have put themselves on record as being actually against the chute delivery as an efficient method of delivering concrete, when, as a matter of fact, the objection should not be to the entire chute system, but rather to the type of chute used. From a standpoint of economy and efficiency, it is not possible to conceive of any better method of placing concrete than by the chute method. The question that might easily arise, therefore, with reference to the chute delivery, should be limited solely and entirely to the *kind* of chute employed.

It has been definitely determined by the National Conference on Concrete Road Building thru the Committee on Mixing and Placing of Concrete, after exhaustive tests, that a road equal in durability to any other, can be obtained by placing concrete thru a swivel spout, *if the chute used is tilted at an angle of not lower than* 20°. It might not be out of place at this moment to suggest that the engineers, in writing up specifications, call for a boom-and-bucket paver or a chute paver, having a tilt of at least 20°.

In fortifying himself against any possibility of not being able to make the fullest possible use of his paving equipment, it is suggested that the contractor observe the following simple rule in purchasing this paving mixer: make it a point to find out from the manufacturer or his agent in definite, unmistakable terms whether the boom-and-bucket paver which he purchases can be converted to chute delivery, or vice versa, should the necessity for that equipment arise. By so doing, he will be protecting himself against any action which "the powers that be" might take on this question. Such convertible pavers are procurable from some of the leading manufacturers.

Safeguarding Profits With Proper Trench Braces

One of the most successful articles in safeguarding the process of a contractor in trench work is a dependable trench brace. The modern contractor appreciates and realizes this, and is constantly seeking improved braces for new work. One of the better types of trench braces, which has been found very satisfactory by contractors, is the Duff Dunn Patent All Iron Extensible Trench Brace. This brace takes the place of the old-style wooden struts, which were always costly, uncertain and unsafe. This all-iron brace is designed for bracing trenches of large widths and depths.

When all of the profit-destroying disadvantages of the old-style method of bracing wood and construction wedges are considered, it can be understood why many contractors are using such improved methods of bracing as the above.

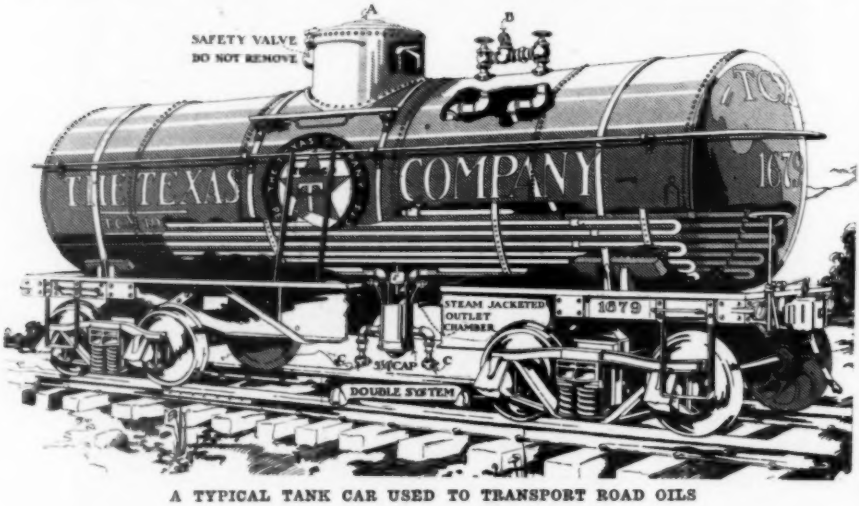
These braces are placed in position, or removed in a few seconds' time, thus effecting large savings in labor cost. When once placed in position, they grip the sheeting firmly. The passing of heavy vehicles, the vibration of trench machinery, or the carelessness of laborers does not jar them loose. When trenches are found to have water at the bottom, or are dug in sandy soil, these braces show their superiority, as any loosening of the sheeting can be taken up at once by merely giving the handle a turn or two.

These braces automatically adjust themselves to any angle by means of the ball-and-socket joint at each end, and with the aid of the lugs on the face of each shoe, sink deep into the trench sides, holding firm, regardless of any sliding or unevenness of the sheeting.

Wrought iron and refined malleable iron are used in the construction of Duff braces, and the central portion of the brace is made of common heavy gas pipe which is either furnished with the brace or purchased by the contractor separately. This brace is also furnished with screw ends, for use with timber struts where desired.

A CHARACTERISTIC EXAMPLE OF THE USE OF DUFF BRACES IN STREET EXCAVATION WORK

Do You Know How to Unload Tank Cars?



A TYPICAL TANK CAR USED TO TRANSPORT ROAD OILS

The unloading of asphalt and road oil from tank cars is a simple, easily accomplished operation, which requires the knowledge of only a few fundamental principles. These primary and all-important principles may be summarized under the three following headings: (A) Dome Cover; (B) Steam Inlets; (C) Steam Outlets. Thoro acquaintance with these factors makes the operation of steam coils in tank cars easy, but ignorance of them often results in an infinite amount of trouble and expense.

These three general headings, each supplemented with specific directions, are given below. In reading these, refer to the above drawing of a tank car of The Texas Company, and follow the lettering carefully.

A—Dome Cover.

(a) Remove while unloading car.

(b) Replace when car is unloaded.

(c) Prevent rain or snow from entering dome to avoid foaming of contents.

B—Steam Inlets.

(a) If car fitted with "duplex" or double-system steam coils and one system is leaking, the other can be used by shutting steam inlet valve "B" of leaky system.

(b) Steam must be turned into coils gradually, to prevent rapid expansion, causing coils to break and leak.

C—Steam Outlets.

(a) Must be wide open when steam is turned into coil.

(b) When live steam begins to show at steam outlets, the outlet valves should be turned nearly off, but must never be entirely closed, otherwise the contents cannot be sufficiently heated.

(c) Open steam outlet valves "C" wide, after car is unloaded, so coils will drain to prevent water from freezing and bursting steam coils or jacketed outlet chamber.

Barber-Greene Increases Selling Organization

Barber-Greene Company, manufacturers of standardized belt conveyors and self-feeding bucket loaders, with factories located at Aurora, Ill., have found that due to the rapidly increasing demand for their loaders and conveyors it has been necessary to augment their selling organization. This company is now represented by R. E. Foulke, 404 Third National Bank Building, St. Louis, Mo.; J. A. Gurney, 605-606 Arrott Building, Pittsburgh, Pa.; F. S. Sawyer, 1010 Penn Square Building, Philadelphia, Pa.; W. T. MacDonald, 305 Merchants Bank Building, Indianapolis, Ind. These are all direct Barber-Greene branches, and the representatives are experienced engineers, well qualified to furnish valuable service and engineering advice to all individuals and firms having material-handling problems.

An Excavating Grader for Heavy Work

The ever-increasing demand for streets and alleys of a permanent character has resulted in a new demand for the construction of machines that will excavate old macadam as well as earth.

The Koehring Machine Company of Milwaukee, Wis., manufactures an excavating grader designed to fulfill this requirement. It has proved its capability, not only as a highway machine, but also as a dirt mover of great capacity. At the Aberdeen Proving Grounds, Aberdeen, Md., it showed itself capable of excavating from 600 to 1,000 cubic yards of earth per day, dependent only upon the available teams and the depth of cut. In highway work it has given a similar account of itself.

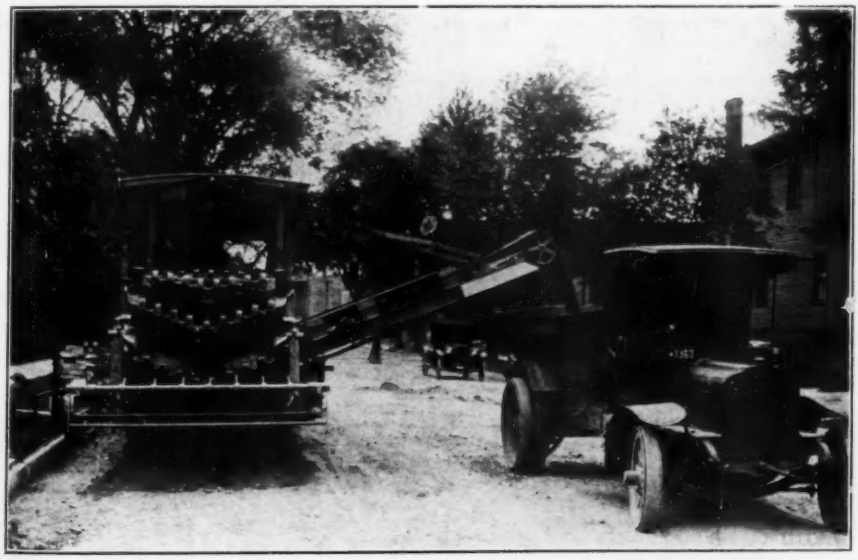
The accompanying illustration is from Chicago, where the R. F. Conway Company was tearing up an old macadam street preparatory to placing an asphalt pavement on a concrete base.

It is established by actual performance that this machine effects a tremendous saving in the pay-roll and at the same time frees the contractor from the difficulties of a tight labor market. When it is realized that the utmost capacity of a hand shoveller is five wagons per day and that the easy capacity of this rotary grader is 600 wagons and over per day, the cost-cutting of this machine is apparent, to say nothing about the greater number of jobs it enables the contractor to complete in a season.

Thruout, this machine is of heavy-duty construction. Control is completely centralized in the operator's cab, from which the cutting wheel is raised or lowered and the machine sent forward at its various speeds, or reversed. Short turning is accomplished by separate control for each set of caterpillars, enabling one set of caterpillars to "walk around the other," practically turning the machine within its length.

The Koehring rotary grader is a power-driven machine which moves forward under its own power, cutting out the road-bed and elevating and loading the material into trucks or wagons in position alongside. The digging function is accomplished by a rotating cylinder on whch are mounted twelve herringbone-shaped buckets, carrying rooting teeth on their cutting edges. The excavated material is carried up by the buckets as the cylinder rotates, and is dumped on the belt of the delivery conveyor, installed to extend at right angles out from the grader on either one side or the other so as to discharge the material directly into wagons, trucks or cars.

The cutting wheel is adjustable vertically to make a cut from 1 inch to 3 feet deep. Cuts are 5 feet 7 inches wide. While the digging wheel is in action, the entire machine moves forward at any of four speeds according to



EXCAVATOR LOADING MOTOR TRUCK ALONGSIDE WITH OLD MACADAM

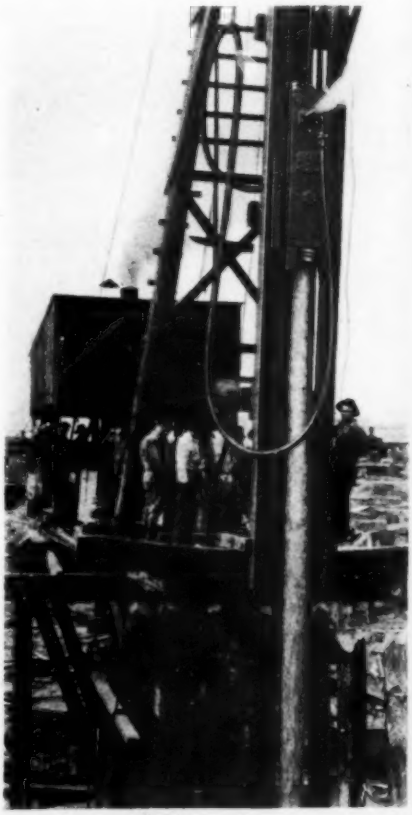
depth of cut and character of material. The operator maintains grade by sighting across properly placed grade stakes. All operations are controlled by centralized levers in the cab. The weight of the grader is carried on two sets of caterpillars, which do away with planking and prevent settling. Any settling, however, is detected by means of the grade stakes and corrected by elevating the cutting wheel.

The New Orleans Industrial Canal

The now nearly completed industrial canal, connecting New Orleans with the Gulf thru Lake Pontchartrain will save nearly 100 miles in the trip down the Mississippi River to the Gulf. Into this project has gone a forest of timber in the form of piling. These timber sticks average in length from 50 to 60 feet, and have been driven along the line of the canal at all places where concrete foundations are to be erected for piers, wharves, locks, etc. Under one lock in particular 14,000 timber piles have been driven as a support for the floor of the lock, which is concreted to a thickness of 10 feet over the piling.

The character of the material into which the piling was driven made difficult work, as the line of the canal passes across a country where there were encountered, at various levels below the surface, the remains of a cypress forest, which geologists state, covered the country eighteen to twenty thousand years ago, when the site of New Orleans was within what is now known as a region of subsidence. In other places along the canal unending quicksands were met, and again marsh-gas pressure developed, which constantly threatened to blow up the entire bottom of the excavation. Only by protecting the banks and foundations with piling was the construction of this work possible. One gets a realizing sense of the size of the job only when he is told that 100,000 cubic yards of dirt have been excavated from the cut, which goes 65 feet below the surface of the ground. This is only the 1/100 part of the total excavation for the entire 6 miles of canal. It would take 10,000 flat cars to carry this dirt, a train 100 miles long. The canal project, when completed, will cost somewhat over $20,000,000, and the opening up of New Orleans' back door will develop new industrial sites along its course, and furnish fixed level facilities for river and ocean trade, giving cheap water connection with the coal fields of Alabama, and putting New Orleans 40 miles closer to the sea.

On this work, dredging machinery and pile-driving apparatus have played the most important part. The driving of the enormous timber piling has been the work of months for scores of pile-driving rigs. In the illustration is shown one of a number of 9B Pile Hammers manufactured by McKiernan-Terry Drill Company, New York, that have done yeoman's service on this noteworthy project. For very nearly two years these hammers have worked steadily and consistently without any slowing up for repairs or adjustment, and, according to those in charge of the work, have driven piles as fast as very much larger hammers.



ONE OF THE PILE-DRIVERS THAT MADE THE INDUSTRIAL CANAL A POSSIBILITY

Not only does New Orleans' new canal serve as a short waterway to the sea, but it will also divert the drainage that now goes into Lake Pontchartrain, and make of it a lakeside front yard, which New Orleans will ultimately develop as a bathing beach and district for homes.

Necessity of Providing a Pure Water-Supply on Construction Work

A sanitary water-supply is one of the most important regulators of the health of its consumers. In the past the water-supply problem on big construction work has, unfortunately, been considered a secondary matter. Any kind of water was good enough.

In a construction camp almost any type of water-supply is subject to pollution. Living conditions are, at best, somewhat primitive—they cannot be otherwise. Even water-supplies from deep-well sources are hardly safe. The advantages of modern sanitary control measures have been realized for some time: thus there may be a sanitary latrine system, sanitary fly-proof kitchens, and apparently every reasonable precautionary measure may be taken, still, the pollution of the water-supply by one or two careless individuals can often nullify such well-meant efforts.

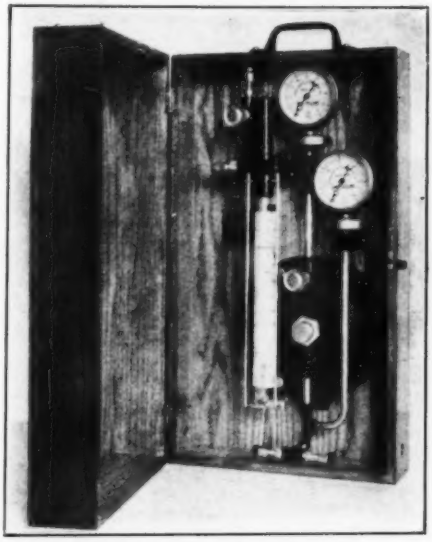
Not only is labor scarce, but its efficiency is greatly under pre-war standards. Every measure should be taken by contractors to keep their men working at highest efficiency. In these days of high cost it is a matter of dollars and cents. A sick man certainly cannot be expected to work as efficiently as one in good health. A man suffering from an intestinal complaint, water-contracted, is obviously not fit; one hundred men in such a condition may turn contemplated profits into actual loss. A severe typhoid fever epidemic may often hold up the construction work entirely.

Water-borne diseases are absolutely preventable. There is no excuse whatsoever for their occurrence. Study statistics of the various state health departments for the last ten years, and you will find that the typhoid fever death rates are, in 1920, about 15 per cent of what they were in 1910. A few dollars expended at the start will prevent many dollars' loss after the work gets under way. If water-borne diseases can be eliminated in the army, they can be eliminated in the construction camp.

A contractor should realize that the water-supply is not a secondary factor, but a factor of first importance. Every care should be exercised in locating its source, especially as regards the possibility of pollution from camp drainage. Measures should be taken to make the controlled water always available for the men.

Chlorination undoubtedly affords the cheapest and most efficient means of water sterilization. Four or five pounds of chlorine gas, costing about 50 cents, is ordinarily sufficient to sterilize as much as one million gallons of water. Cost, therefore, is a negligible factor. The chlorination process is now extensively used: approximately one thousand American municipalities sterilize their water-supplies by its means.

The contractor should adopt the same line of reasoning as was adopted by the American Expeditionary Forces. With but few exceptions the American Army authorities required all drinking water to be first chlorinated, regardless of its previous sanitary quality. The contractor has every reason to act in a similar manner; no matter how excellent his source of supply may appear, the chances of pollution will be abnormally high. He cannot afford to take chances. Even in the permanent United States Army camps the water-supplies are almost without exception chlorinated.



A PORTABLE TYPE OF DRY-FEED CHLORINATOR USED WITH GREAT SUCCESS IN BOTH THE UNITED STATES AND BRITISH ARMIES

Roughly speaking, construction camps may be divided into two main classes: those of a permanent nature, where a stationary water-supply plant can be constructed and sanitary measures installed and, in general, living conditions made to approximate those of an established community; and those of a temporary nature, where extensive sanitary development or control is not possible, and where conditions are, naturally, not as desirable from a sanitary standpoint, and where more care needs to be exercised.

A portable chlorine control apparatus was developed by the Wallace & Tiernan Company for the British Army. It is of the so-called Direct Feed type; that is, the chlorine gas is applied directly to the water-supply. The whole equipment is self-contained in a small cabinet. A control apparatus of such a type can be advantageously used in sterilizing water-supplies in temporary construction camps: no piping or other construction work is required—it is simply necessary to turn on the chlorine.

For camps of a permanent nature, the Solution Feed type chlorinator is sometimes better adapted, altho the Direct Feed type can often

be used. A Solution Feed portable apparatus was designed by the same company for the French Army. With this type equipment it is necessary to furnish a water-supply under about 15 pounds pressure to operate the apparatus. A combination of the two types was developed for the American Army.

It often happens that other treatment than chlorination is necessary. A complete mobile water purification truck, also designed by the Wallace & Tiernan Company, was used by the American Army. Filter, pump, testing laboratory, were provided in addition to the chlorinator. It represents practically a complete water purification plant on wheels.

A contractor should realize that with but small expenditure he can provide his men with just as high a quality of water-supply, from a sanitary standpoint, as that of the developed municipality.

Steel Road Forms Where Mechanical Devices Are Used

The need of specially designed forms for the construction of concrete roads, or roads which have concrete bases, is increasingly appreciated by contractors and engineers, particularly where road machinery, such as mechanical tamping devices and finishers, is used. The Blaw-Knox Company, Pittsburgh, Pa., manufactures special road forms which are particularly adaptable to the service. They are manufactured in two types, A and B. The former are identical in design and construction with the latter, but are of a lighter-gauge material and therefore cheaper, and are made for use when it is neither necessary nor advisable to use mechanical subgrading or finishing machines. The type B forms are extremely strong and heavy, and are used where subgrading or finishing operations, or both, are effected by use of machine. They are made of high-grade blue annealed, open-hearth steel plate, flanged top and bottom and reinforced with heavy plates. The bottom flange of all Special road forms is flat, 3¼-inches wide, and designed to give great bearing surface. The top flange is 2½ inches wide with a 1-inch stiffening edge, making a very substantial and absolutely smooth track. Three steel stakes of the proper length are furnished with each rail. These stakes pass thru the steel straps, which are securely fastened to the reinforcing plates. The stake straps are slotted to receive tapered keys which lock the forms to the stake securely and positively. This arrangement ties the forms to the ground, firmly holds them to line and grade and, where type B forms are used, prevents any movement when the machines are being operated. This arrangement also makes possible the supporting of the form against the vibration developed by the machine, prevents oscillation or movement of the forms, and at the same time causes the stake to act like the buttress of a retaining wall, holding the form in position against the overturning action of the machine.

FORMS DESIGNED ESPECIALLY FOR ROAD CONSTRUCTION WHERE SUBGRADING OR FINISHING OPERATIONS, OR BOTH, ARE EFFECTED MECHANICALLY

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"This Company is a believer, from actual experience, in motor-driven equipment, and just as soon as we are in shape to enlarge our fleet of trucks, we have no other thought than to increase it by adding Selden Trucks to same. We know that materials to be hauled, with the proper organization, can be better transported and delivered cheaper, by trucks than in any other manner.

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Pages 3 to 33?

The "Where to Purchase" Section contains the names and addresses of the leading manufacturers and supply dealers. This is the quickest way to secure favorable prices and other information.

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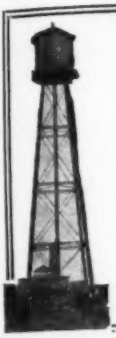

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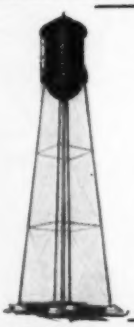

BUILD FOR THE FUTURE

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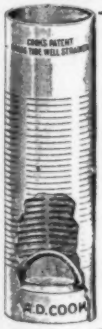

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Cook Patent Brass Tube Well Strainer

Write for Bulletin 30.

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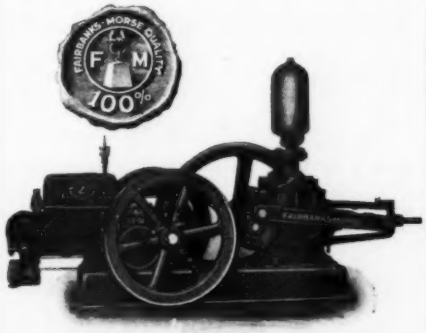

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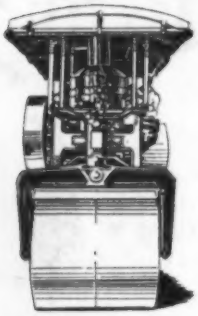
INDEX TO ADVERTISERS

After referring to the "Where to Purchase" Section, on pages 3 to 33, if you will look up the advertisements as per index below, you will be able to secure further data (with illustrations in many cases) on the material or equipment relative to which you are seeking information.

Contractors'—Engineers' Purchasing Guides



Front view of the new Iroquois Macadam Roller, showing sturdy construction of king post, yoke, etc.

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make certain it contains the following features. They mark the difference between efficiency and inefficiency, economy and high-cost.

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9—POWER greater than old type rollers because of higher steam pressure and larger engine cylinders.

10—BE SURE the roller is an

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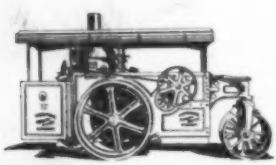
and you will be sure it contains all the other points. Send for full and detailed specifications to



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